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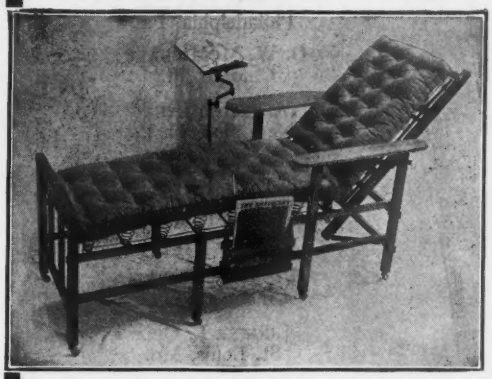

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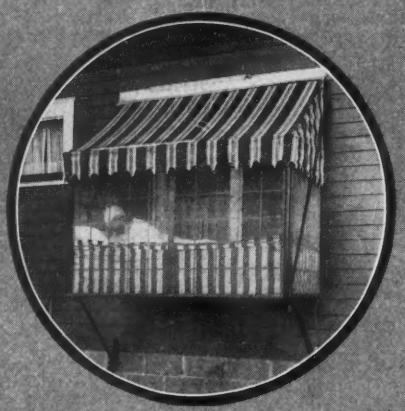

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STEREOROENTGENOGRAMS OF THE INJECTED LUNG AS AN AID TO THE STUDY OF THE LUNG ARCHITECTURE

WILLIAM SNOW MILLER

From the Kenneth Dows Fund for the Study of Tuberculosis, of the Medical Clinic of the Johns Hopkins Hospital and University, Baltimore, Maryland

In a previous communication I have given the general directions for the preparation of a differential injection mass which is especially applicable to the study of the distribution of the blood vessels within the lung by means of stereoroentgenograms for it clearly brings out their relation to the bronchi, to each other, and to the lobation of the lung. The basis of the injection mass consists of a suspension of corn starch in 70 per cent alcohol to which vermilion granules are added when it is desired to obtain a uniform dense shadow and ultramarine blue granules when a less dense and finely granular shadow is desired as a differential injection mass. By the use of a greater or less quantity of the 70 per cent alcohol the injection masses may be made to penetrate to any desired distance within the lung. If the bronchi alone are to be injected a thick vermilion mass gives the best results; for if the mass be too thin it will penetrate the air sacs and a blurred shadow will result or else the whole lung will appear solid.

The relation of the pulmonary artery, the pulmonary vein, and the bronchi to each other can be summarized as follows: The pulmonary artery follows in all of its subdivisions the subdivisions of the bronchial tree. As each main branch of the pulmonary artery arches over its corresponding stem bronchus it comes to occupy a position posterior (dorsal) and slightly lateral to the bronchus. The relation of the main trunks of the pulmonary vein to the bronchi is quite different; they are situated anterior (ventral) and mesial to their stem bronchi and in their ultimate distribution are situated as far removed from the bronchi as possible. I lay emphasis on "as possible" for in some situations they are found near the bronchi but never as closely associated with it as is the artery. In one of the illustrations frequently used to show the relation of the pulmonary artery to the stem bronchi (that of Aeby)

the position of the artery is correctly shown in the right lung, but in the left lung the position is reversed. The diagram given by Merkel is correct.

Keeping these relations in mind let us consider some of the practical applications of these injection masses to the anatomy of the lung and for this purpose the lung of the pig and of the dog will be used. In plate 1, we have a stereoroentgenogram of the lung of a pig in which the pulmonary artery was injected with the vermilion starch mass and then distended with air. The heart has been removed and the free portion of the artery has been reflected anteriorly in order that the cannula and its clamp may not interfere with a clear picture of the bifurcation of the trachea and the main venous trunks which pass to the lower lobes of the lung. We recognize at once the dense shadow caused by the injected artery and we can follow its ramifications until they are lost just beneath the pleura. Lying on the mesial side of the artery in each lung we can recognize a hollow tube which, as we trace it anteriorly, joins its fellow and forms the trachea; these are the main stem bronchi. Situated on the mesial side of each stem bronchus a third shadow, a trifle denser than the air-distended bronchi, can be seen; this is the main stem of the pulmonary vein. Because the artery has been filled with a distending injection it is pushed more to the lateral side of the bronchus than normal and therefore throughout the greater part of its course appears to be situated at one side of the bronchus. It is, however, more closely applied to the bronchus than the vein which shows an appreciable space between it and the bronchus throughout its entire course. The angle at which these three vessels enter the hilum of the lung differs on the two sides, on the right side the bronchus and artery enter the hilum pulmonis at a more acute angle than on the left side. The interweaving of the artery, bronchus, and vein which shows so distinctly in the lobus medius and the lobus superior of the right lung and in the lobus superior of the left lung is quite different from the hazy, smoky areas which are present in the early stages of tuberculosis.

In plate, 2, we have a stereoroentgenogram of the lung of a pig in which the pulmonary vein of the left lobus inferior was partially injected with a thick ultramarine blue starch mass and then distended with air. The pulmonary vein can be clearly seen situated anterior and mesial to the main stem bronchus. This relation, to one who is not familiar with the architecture of the lung, is not so apparent in the preceding stereo. The pulmonary artery, because of its position and because it is unin-

jected is not easily recognized; but if the walls of the stem bronchi, especially that of the right lobus inferior, be closely studied it will be seen that the lateral wall is denser than the mesial wall and if this density be followed forward it will be found to be the continuation of the main trunk of the pulmonary artery which can be seen just beneath the point where the glass cannula which is inserted into the pulmonary vein is connected with the short piece of rubber tubing. The second ventral branch of the stem bronchus in the left lobus inferior also shows in a characteristic manner the same increased density. In the left lobus superior it is the conformation of the lobe and a thin sheet of connective tissue that occasion the apparent thickening of the lobus. This increased density of the lateral wall of the bronchus is frequently seen in stereos of the human lung when from any cause (heart lesion) there is unusual distention of the pulmonary artery. In like manner any lesion causing distention of the pulmonary vein may occasion an increased density of the mesial wall of the stem bronchus.

The thesis has already been advanced that the bronchus and artery are closely related to each other while the vein is as far removed from the bronchus as possible. In the left lobus inferior when the course of the veins is in a horizontal plane there can be seen, between the injected veins, less dense shadows. As these are followed toward the mid-line they are found to join the stem bronchus; these densities are occasioned by the lateral branches of the stem bronchus. We find then a vein between two bronchi or, better, a bronchus between two veins. As these branches are followed through all parts of the lobe the veins appear to change their relation to the bronchi. This is due to the natural curvature of the lung, a fact that is sometimes overlooked in studying roentgenograms of the lung.

In the middle zone (third) of the lobus inferior of the right lung there can be seen scattered along the bronchi circular areas which show increased density. These are usually explained as being occasioned by a bronchus of the third or fourth order extending directly towards or away from the observer. If these densities be carefully examined they will be found to be of larger size than adjoining bronchi and often irregular in their contour. That these densities are due to bronchi alone may be true in some instances; that in the majority of instances they are occasioned by cartilages of peculiar form, which may or may not show a small amount of calcification, will be brought out in a forthcoming publication by the author. These circular densities are not

always seen in a horizontal plane but, as for example in the right lobus superior, they may have an oblique position as regards the observer. Scattered along the right stem bronchus densities, due to the supporting cartilages, can be recognized in the angle between the stem bronchus and its branches. With a little study these densities can be differentiated from that due to the pulmonary artery.

In plate 3, we have a stereoroentgenogram of the lung of a dog in which the pulmonary artery was injected with a vermilion starch mass and the pulmonary vein with an ultramarine blue starch mass. The uniform dense shadow is the artery; the less dense and finely granular shadow is the vein. The bronchi do not show, being obscured by the injection of both the artery and vein. The lung is rotated slightly to the right and the heart is displaced forward in order that the main blood vessels can be clearly seen. This brings the left pulmonary artery into a prominent position in the upper part of the stereo. The small artery clamp was used to close a leak which prevented the lung from being fully distended.

In studying this stereo it should be kept in mind that the position of the lung is different from that in the two preceding stereos. In this stereo the dorsal surface of the lung is directed obliquely towards the observer and the trachea is at the right; in the other two the dorsal surface of the lung is away from the observer and the trachea is at the top of the stereo.

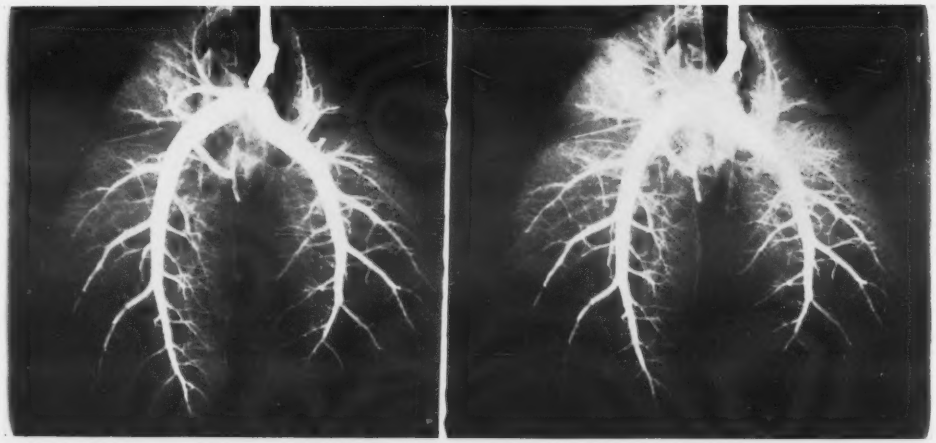
SUMMARY

1. By the use of differential injection masses in the pulmonary arteries and veins the relations of these structures are plainly outlined by stereoroentgenograms.

2. Even though the pulmonary arteries are uninjected, they can be recognized in stereoroentgenograms as comparatively dense linear markings along the lateral wall of the bronchi. Under similar conditions the main venous trunk can be made out on the mesial side of the stem bronchus, but in its ultimate distribution its branches are not associated with the bronchi.

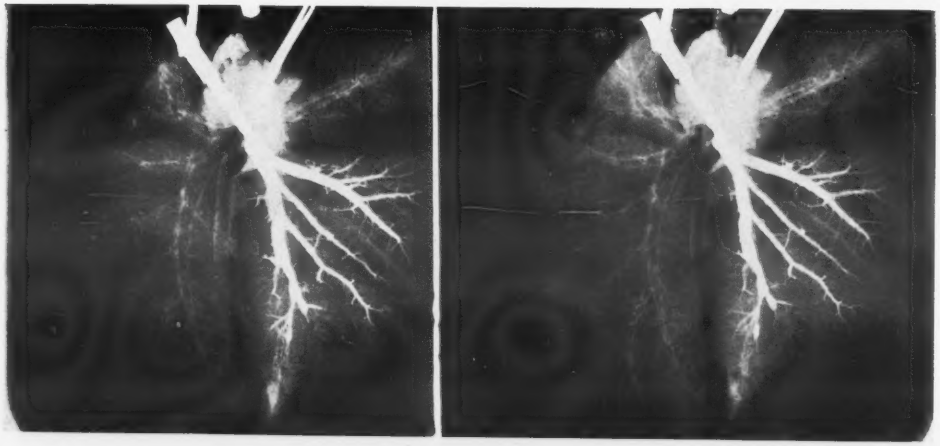
3. In reading X-ray plates care should be exercised not to mistake these linear markings for densities produced by pathological changes.

4. Ring-like shadows with sharp borders that appear along the bronchi are often due to the plane that the bronchi bear to the observers.



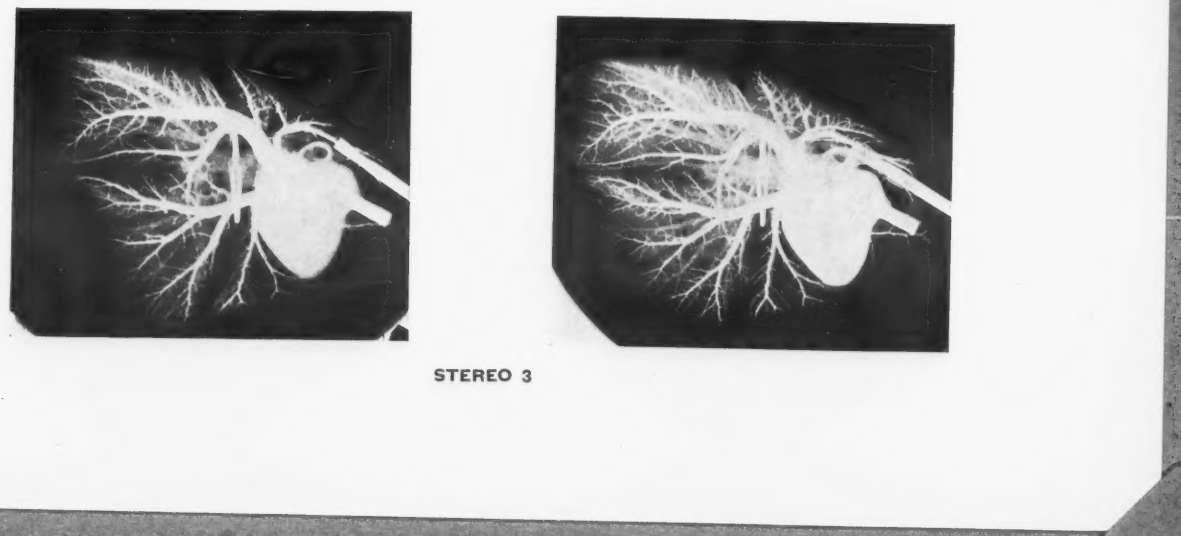
STEREO 1

(Miller: Stereoroentgenograms of Injected Lung)



STEREO 2

(Miller: Stereoroentgenograms of Injected Lung)



STEREO 3

(Miller: Stereoroentgenograms of Injected Lung)

When these ring-like shadows are broad with irregular hazy borders, they are cast by bronchial cartilages.

5. This study suggests once more the importance of a knowledge of lung structure for one in interpreting densities cast on the X-ray plate.

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A STUDY OF PULMONARY AND PLEURAL ANNULAR RADIOGRAPHIC SHADOWS

TOGETHER WITH NOTES ON INTERLOBAR FISSURES

H. L. SAMPSON, F. H. HEISE AND LAWRASON BROWN

From the Trudeau Sanatorium, Trudeau, New York

A number of articles have appeared from time to time dealing with "silent" or unrecognizable cavities. Since the X-ray has been more widely employed in chest work the number of these so called "silent" cavities has greatly increased, for it has been the practice of many workers to interpret all annular X-ray shadows as intrapulmonary cavities. It is our purpose to attempt to show that many of these "cavities" are not intrapulmonary but interpleural and situated between the lobes or between the lung and the chest wall, or, in other words, that they are often interlobar pneumothoraces or hydropneumothoraces, or the usual localized pneumothorax.

In attempting this study it is necessary to review the usual physical and X-ray signs of intrapulmonary cavities and then attempt a differentiation of the pneumothoraces, as we interpret them, from the cavities.

BRIEF SUMMARY OF LITERATURE

The occurrence of interlobar pleurisies has long been recognized. Laennec refers to dry, serous, and purulent pleurisies between the lobes, and states that Bayle recognized such a condition. Dry pleurisies in this situation are frequently met with at autopsy. French literature has dealt earlier and more fully with this subject, and attention may be called to the works of Beclere and of Chantemesse and Courcoux. A. K. Stone (1), in this country, called attention to interlobar exudates in an excellent article, and Musser (2) to purulent exudates. Gerhardt (3) has emphasized the subject in Germany.

Interlobar pleurisies with exudates are not difficult of diagnosis, and we shall not deal with them in this paper. While Berger in his thesis (Pleurisie interlobaire d'origine tub. et particulairement de la forme seche, Paris, 1908) states that dry interlobar pleurisies admit of diag-

nosis by physical signs, such has not been our experience. The physical signs occur about the fissures and there only, he states. Opposite the third and fourth vertebral spine is the most common seat, and, next to this, the point of departure of the smaller horizontal from the large fissure on the right. The diagnosis of purulent interlobar pleurisy depends upon the presence of signs of vomica with hemoptysis, with fetid sputum. When the fluid is serous, signs of suspended dulness and puncture by a needle may make the diagnosis clear, but in all these conditions roentgenography speaks the *final* word. Here is shown a dense shadow with clear lung above and below it.

While Fishberg (4), in a recent article, mentions interlobar pleurisy complicating pulmonary tuberculosis, his article deals with partial pneumothorax rather than the small localized pneumothorax indicated by the shadows described in this article. Barjon (5), on the other hand, describes very briefly limited or encysted pneumothoraces and mentions that they may be interlobar and completely disappear, but he fails to emphasize the points that are dealt with in this article.

THE ROENTGENOGRAPHIC STUDY

That nearly all intrapulmonary cavities cast either a simple rarefication or a "rarefication complex" on the plate and screen is quite probable. Whether or not these areas of greater transmission of ray are seen depends upon the size, shape, and position of the cavity and the density and character of the adjacent tissue. There is probably no single roentgenographic manifestation or combination which is diagnostic. The absence or marked diminution of lung markings inside an area or areas of rarefication is the most dependable and if the size and position of such an area or areas are taken into account a diagnosis of cavity can be made with much assurance. A somewhat circumscribed area of rarefication inside a consolidation or marked infiltration is also of much value and fairly reliable. Here, however, pleurisy, with or without effusion, should be differentiated from consolidation. Multiple small areas of rarefication resembling a honeycomb situated in denser lung tissue is also of extreme value. (See Mantoux and Maingot, *La Presse Medicale*, March 7, 1918.)

A manifestation that leaves one in much doubt as to its diagnostic value in relation to intrapulmonary cavity is the annular or ringlike shadow, varying in shape, seen many times in normal or mildly in-

filtrated lung fields, and it is this picture that we have attempted to investigate. Many times more ray is absorbed inside these annular shadows than in the surrounding lung tissue; in a small percentage of cases more ray is transmitted through this ring; while in about 60 per cent of the instances the transmission is the same. Lung markings are profuse in many of them even when the size is extreme, occupying an entire apex or upper third.

The profusion of lung markings, the greater or equal absorption of ray through these annular shadows and also the fact that certain of them change their shape and size rapidly, make one very skeptical as to their value in the diagnosis of intrapulmonary cavities. (In many instances some as large as 3 to 5 cm. disappeared in from three to six months, or became larger and then smaller and then finally disappeared.)

In the fifty cases studied the following changes took place during various intervals of time:

	per cent		*per cent*
Enlarged	18	Appeared when not previously present	20
Diminished	26	Increased and then diminished	14
Disappeared	14	Change not known	4
Remained the same	4		

That a few of these annular shadows are the walls of intrapulmonary cavities cannot be denied, but the presence of other confusing shadows makes it almost impossible at times to draw definite conclusions.

The character of these annular or ringlike shadows varies exceedingly. At times they are like a ring of dense fibrous tissue; at other times, like a circular deposit of fibrinous exudate; and lastly they may also appear fairly broad (ribbonlike) and homogeneous. In many instances the lower margin is horizontal (possible fluid level). This occurs more frequently in the last two types. Seventy per cent of these shadows are above the third rib; the rest are scattered anywhere in the lung field. They have been referred to as annular shadows; nevertheless their shape may be ovoid, triangular, more or less rectangular, or have no definite shape.

The constant recurrence of these annular shadows forced them upon our attention, and in going over 423 consecutive cases admitted to the Trudeau Sanatorium we found these annular shadows occurred in 50 cases, or 11.8 per cent.

At first we interpreted these annular shadows as intrapulmonary cavities, but as time went on we grew skeptical. That they contained

fluid could not be denied, for the lower demarcation always remained horizontal, no matter what position the patient assumed. This change occurred immediately and before the fluoroscope. When the patient was shaken, change of fluid level was observed. As this could only take place in the presence of air, we were finally forced to the conclusion that we were dealing with a definite cavity, containing fluid and air. The location of this cavity was still uncertain, and this paper contains the results of our study of the locations of these annular shadows and cavities, and their significance.

THE PULMONARY FISSURES

It is difficult for most students to obtain a clear mental image of the pulmonary fissures and the lobes they separate, but to understand interlobar pleurisies it is necessary to visualize the lobes and fissures. Beginning opposite the fourth vertebral spine on the right, the third on the left side, the greater fissure runs along the pulmonary surface obliquely downward and around the lung, reaching the anterior border under the sixth costal cartilage. From here it crosses the diaphragm, running obliquely and posteriorly to the mesial surface, where it rises abruptly to end at the root. Above the root it rises along the paravertebral surface. On the left it passes under the fifth rib and on the right under the fourth and fifth ribs. Beginning just anterior to the posterior axillary line in the fourth interspace the lesser or horizontal fissure runs almost horizontally, possibly slightly upward or downward, to the anterior border of the lung, ending under the sternum opposite the junction of the fourth costal cartilage. The left greater fissure is more vertical than the right.

The deeper course of the main fissure is not so easily grasped. Few appreciate the fact that it extends inward to the main bronchus at the root of the lung, which on the right may be said to be the crossways of the fissures (greater or oblique and lesser or horizontal). The lung is divided into two nearly equal parts by the oblique fissure, and on the right the upper part is again divided by the horizontal fissure in two parts. These subdivisions are called lobes; upper, middle and lower on the right; upper and lower on the left. The horizontal fissure as it runs backward from the fourth costal cartilage and interspace inclines slightly upward. At times it may be separated in part from the greater fissure by an apparent fold of the pleura. The middle lobe extends

about two-thirds through the lung, and can be considered a wedge placed between the upper and lower lobes. It forms from one-fifth to one-third of the base of the right lung, while the lower lobe forms the remainder. On the left the lower lobe forms most of the base. (See fig. 1: Longitudinal section of right lung showing various locations of interlobar and mural localized pneumothoraces.)

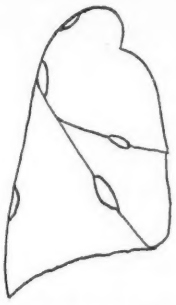

FIG. 1. LONGITUDINAL SECTION OF RIGHT LUNG, SHOWING LOCATIONS OF INTERLOBAR AND MURAL LOCALIZED PNEUMOTHORACES

PHYSICAL SIGNS OF INTRAPULMONARY CAVITY

The physical signs of intrapulmonary cavity are notoriously uncertain. Inspection, mensuration, and palpation yield no evidence worthy of consideration. From percussion we obtain certain signs that occur both with and without cavity but are suggestive of it. To obtain these signs the cavity must be peculiarly placed. Localized tympanitic resonance in an otherwise dull area, or amphoric or cavernous resonance, is very suggestive. The cracked-pot note may occur in a normal chest with increased elasticity, but is always very suggestive, especially if metallic, in the presence of advanced disease, of a cavity. Wintrich's change of note produced by opening (higher note) and closing (lower note) the mouth, and that caused by change of position (Gerhardt's) are of little help to most clinicians, and are rarely used. Of all signs of percussion the note with a metallic quality is most characteristic.

The evidence furnished by auscultation is the most trustworthy, but at times even this is misleading. The quality of the respiration depends upon the condition of the pulmonary tissue surrounding the cavity and upon its location. Tubular, cavernous, or amphoric breathing may be present, or the modification of the normal breath sound

may be slight. The most intense cavernous or amphoric whisper may make the ears ring and seems immediately under the bell of the stethoscope, but these signs may be absent or so slight that diagnosis of a cavity is mere supposition. Pectoriloquy may replace the intense bronchophony. The râles are often described as gurgling, resonant, metallic or cavernous. Metallic tinkling may, but rarely does exist.

On the other hand, there are "silent" cavities where breathing is absent and no râles occur, but vocal resonance is usually increased and a cracked-pot note is present. The usual site of these is above the clavicle. The cracked-pot note is heard only when the cavity is in the anterior upper part of the lung. In fact the site of the cavity has much to do with its detection and stands second in importance only to the condition of the surrounding tissue. Some hold a cavity the size of a cherry (2 x $2\frac{1}{2}$ cm.) can be detected if situated just below the pleura and surrounded with condensed tissue, while if more deeply seated and especially if surrounded by approximately normal lung tissue it may be the size of a small orange and escape detection. A small bronchus surrounded by consolidated lung containing considerable fluid secretion may closely simulate a cavity.

Of course to be diagnosable a cavity must contain air, for when filled with secretion a cavity containing one-half to one litre may be unrecognizable. For many signs the cavity must communicate freely with the bronchus. The walls must also have some flexibility and be more or less smooth. A cavity near the pleura may show no râles as no pulmonary tissue may overlie it and it may contain at the time no secretion.

In unusual instances the cavity may be so large that hydropneumothorax is diagnosed and a succussion splash obtained. Post-tussic suction while not constant occurs over some cavities with fairly elastic walls. The coin sound may also be obtained in rare instances. On the other hand, when the cavity is small and surrounded by tissue crowded with tubercles and oedematous, or by emphysematous pulmonary tissue, there may be no signs of cavity.

In a study of fifty cases, Norris found whispering pectoriloquy (91 per cent), tympany (67 per cent), cavernous or amphoric breathing (65 per cent), and gurgling or consonating râles (58 per cent) to be the most trustworthy signs of cavity.

PHYSICAL SIGNS AND SYMPTOMS IN PATIENTS WITH ANNULAR SHADOWS

A comparison of the physical signs, symptoms, and other findings was made in the fifty cases showing these annular shadows in comparison with the clinical findings in another series of fifty cases in which the annular shadows were not present. Both series were composed of cases with definite parenchymatous lesions. Of course the number of cases thus compared is extremely small and for this reason the percentages given are not to be accepted as accurate. However, the results of the comparison are as follows:

The onset was insidious in 48 per cent and catarrhal in 32 per cent of the cases showing the annular shadows, as against insidious in 24 per cent and catarrhal in 50 per cent of those not showing the shadows. Pleuritic and hemoptoic onsets were of approximately the same frequency in both classes. Strange as it may seem, pleurisy with effusion occurred in only 6 per cent of these cases with annular shadows as against 14 per cent of those without. Dry pleurisy occurred with about equal frequency. The patients with annular shadows had at the onset an acute illness in 30 per cent of the cases; those without, in 48 per cent.

Physical signs of infiltration, or those which could be interpreted as being evidence of consolidation or cavity, occurred with the same frequency in both classes.

Râles, moderately coarse and fine, occurred in approximately the same percentage of both classes, moderately coarse râles (7 to 2) predominating, and the actual percentages being 100 per cent of those with the annular shadows and 96 per cent of those without.

Hemoptysis occurred in a greater number of those not having the annular shadows, 54 per cent, than in those in which the shadows were present, 30 per cent. Streaked sputum, without hemoptysis, on the contrary, occurred more frequently, 28 per cent, in those cases with annular shadows than in those without, 14 per cent.

Tubercle bacilli appeared in the sputum more or less constantly upon examination at the Sanatorium and previous to entrance in more cases with the annular shadows (44 per cent) than in those without (18 per cent). They occurred periodically in the sputum in approximately the same percentage of the cases in both groups, with (48 per cent), and without (52 per cent). However, tubercle bacilli were never found, or there was no expectoration, in more cases without annular shadows (30 per cent) than with (8 per cent).

The cases with annular shadows showed a greater tendency to relapse, a rather serious relapse occurring in 24 per cent of those with, and in only 8 per cent of those without. Milder relapses occurred in 26 per cent of those with and 18 per cent of those without the shadows. Therefore, it is perhaps quite natural to expect that the condition of the cases at the time of discharge from the Sanatorium would show a much greater percentage of unimproved among those patients with the annular shadows than among those without. This is shown in the appended table 1.

TABLE 1

Comparison of cases with annular shadows with definite parenchymatous lesions, with those having no annular shadows

	ANNULAR SHADOWS	NO ANNULAR SHADOWS
	per cent	*per cent*
Onset:		
Insidious	48	24
Catarrhal	32	50
Pleuritic	14	16
Hemoptoic	6	6
Febrile	0	4
Pleurisy with effusion:	6	14
Dry	76	74
No pleurisy	18	12
Tubercle bacilli:		
Present constantly	44	18
Present periodically	48	52
Absent	8	30
Râles:		
Moderately coarse	90	84
Fine	10	12
No râles	0	4
Hemoptysis 1 ounce or more	30	54
Streaked sputum	28	14
Physical signs		
Infiltration	88	88
Consolidation or cavitation	12	12
Relapses at sanatorium		
Serious	24	8
Not serious	26	18
No relapse	50	74

SUMMARY AND CONCLUSIONS

This study of fifty cases, unselected from a much larger number, has led us to conclude that annular shadows, surrounding areas of increased or equal absorption of the ray, occur in patients more likely to be suffering from pulmonary softening, and indicate rupture of the lung. Owing to the presence of adhesions only partial pneumothorax, with or without fluid, results. The site of the pneumothorax depends upon the location of the softened focus and usually occurs in the upper part of the greater oblique fissure and in the horizontal fissure on the right. These pneumothoraces can rarely be diagnosed clinically and indicate a somewhat graver prognosis. They occurred in 11.8 per cent of 423 cases.

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(3) Gerhardt: Muench. med. Wchnschr., 1907, 911.
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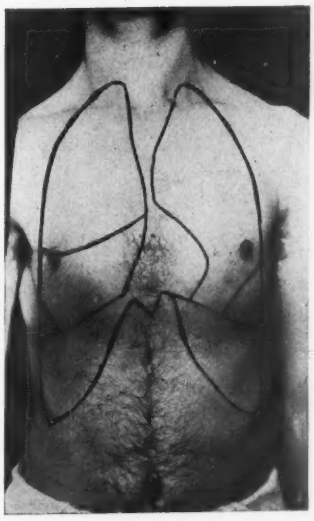
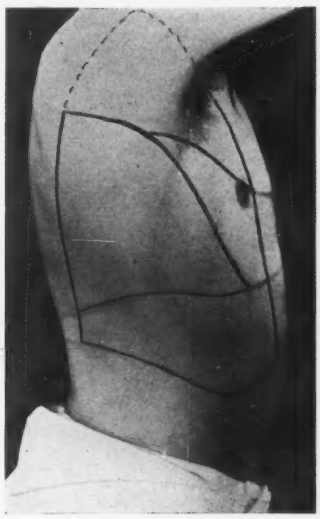


a



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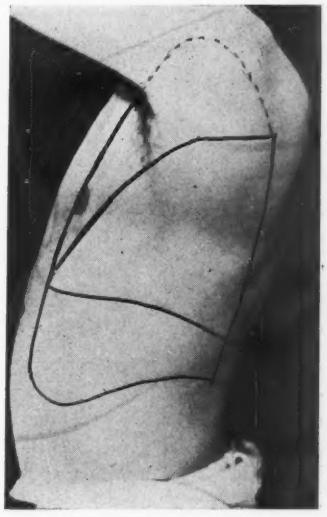

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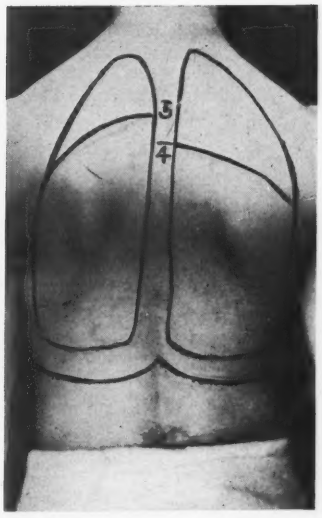


d

FIG. 2 (*a*, *b*, *c* AND *d*). PROJECTIONS OF FISSURES ON CHEST

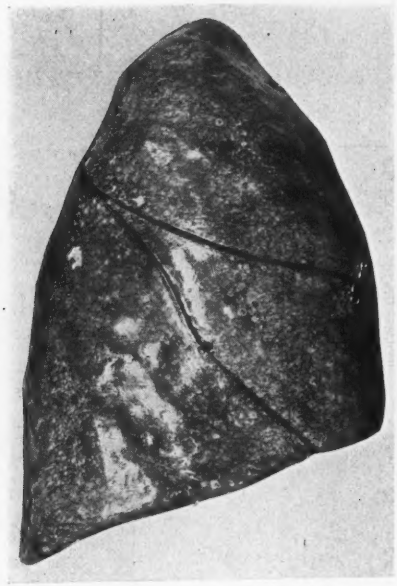


FIG. 3. AXILLARY VIEW OF RIGHT LUNG, SHOWING LOBES AND HORIZONTAL (UPPER) AND OBLIQUE (LOWER) FISSURES. (JAPANESE MODEL)

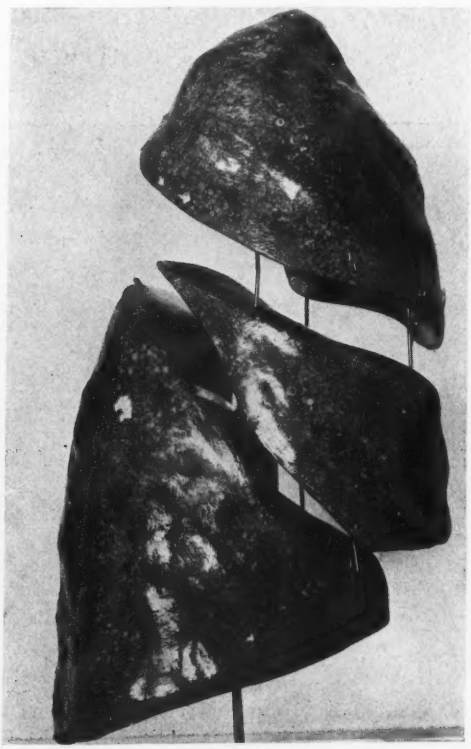


FIG. 4. AXILLARY VIEW OF RIGHT LUNG WITH LOBES SEPARATED

FIG. 5. MESIAL VIEW OF RIGHT LUNG SHOWING SAME LOBES AND FISSURES AS FIGURE 3

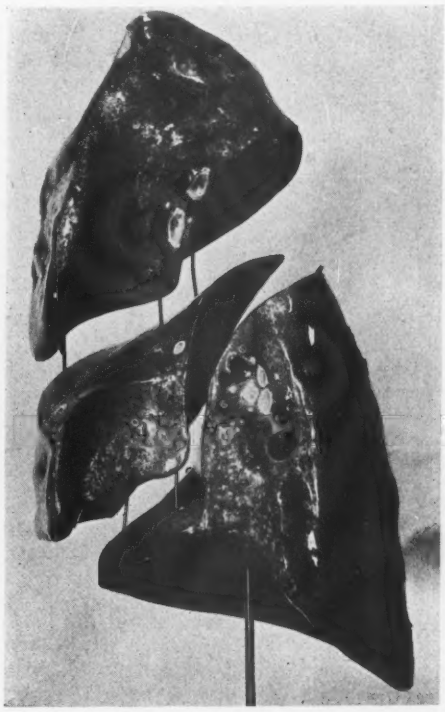


FIG. 6. MESIAL VIEW OF RIGHT LUNG WITH LOBES SEPARATED

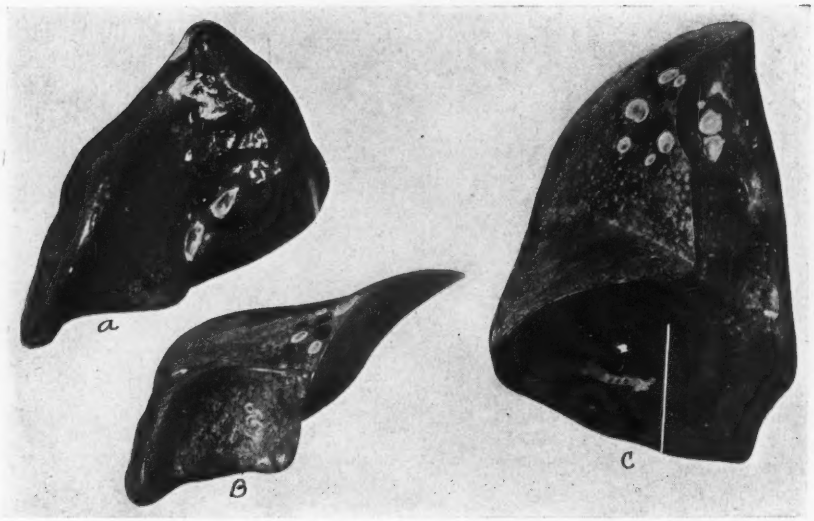


FIG. 7. RIGHT UPPER (*a*), MIDDLE (*b*) AND LOWER (*c*) LOBES

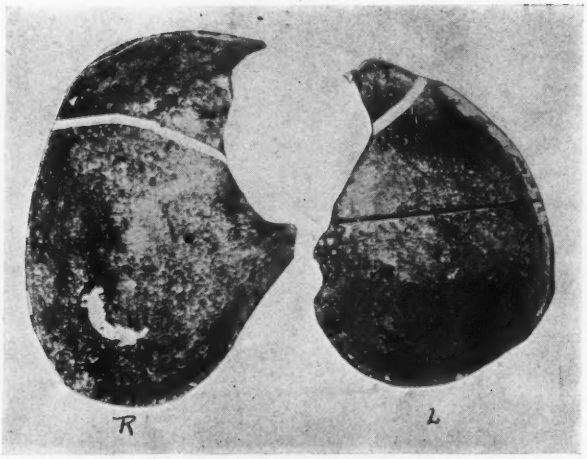


FIG. 8. DIAPHRAGMATIC SURFACE OF RIGHT (*R*) AND LEFT (*L*) LUNGS SHOWING COURSE OF OBLIQUE FISSURE OVER DIAPHRAGM

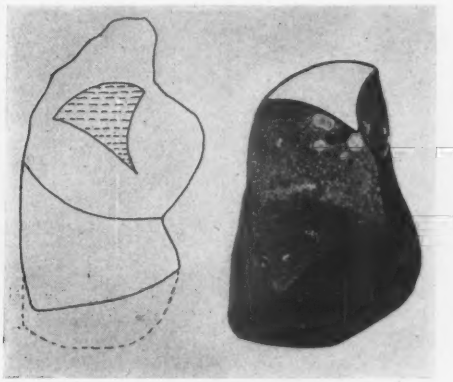


FIG. 9. SHOWS CONTACT SURFACE (DOTTED AREA) BETWEEN THE UPPER AND LOWER LOBES, WITH ACCOMPANYING PHOTOGRAPH

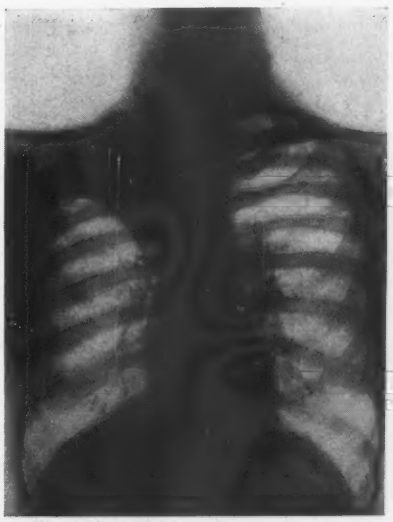


FIG. 10. INTERLOBAR PLEURISY BETWEEN UPPER AND LOWER LOBES (COMPARE WITH FIGURE 9)

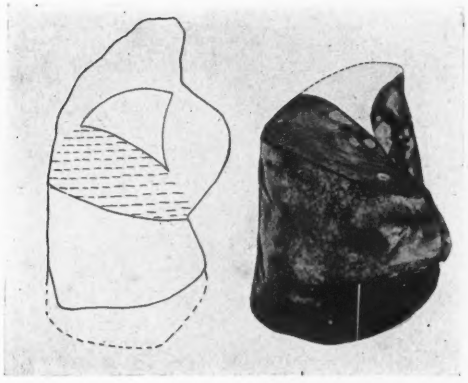


FIG. 11. SHOWS CONTACT SURFACE (DOTTED AREA) BETWEEN THE UPPER AND MIDDLE LOBES, WITH ACCOMPANYING PHOTOGRAPH

FIG. 12. ILLUSTRATES AN INTERLOBAR PLEURISY BETWEEN THE UPPER AND MIDDLE LOBES (SEE FIGURE 11)

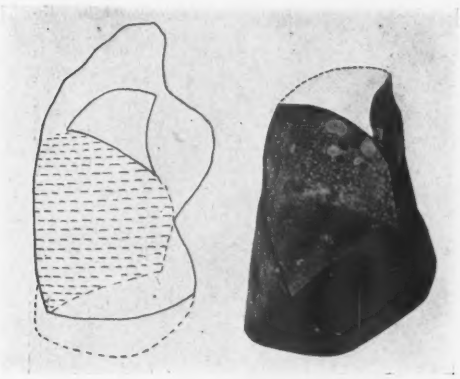
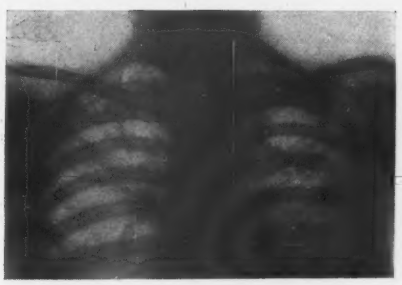


FIG. 13. SHOWS CONTACT SURFACE (DOTTED AREA) BETWEEN THE MIDDLE AND LOWER LOBES

a



b

FIG. 14 (*a* AND *b*). INTRAPULMONARY CAVITIES SHOWING AREAS OF RAREFICATION AND ABSENCE OR DIMINUTION OF LUNG MARKINGS IN MORE OR LESS DENSE LUNG TISSUE

a

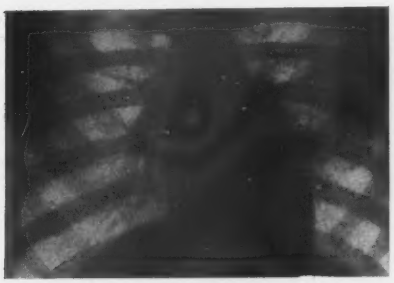
b

c

d

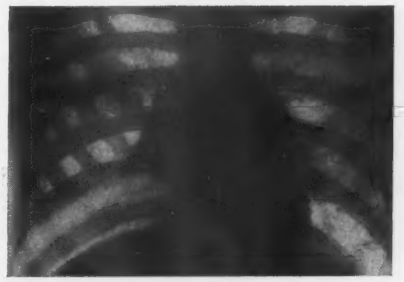
FIG. 15 (*a*, *b*, *c* AND *d*). CASE 4721, SHOWING CHANGE IN SHAPE AND SIZE OF ANNULAR SHADOW

Plates taken at about four months' intervals. Note absence of rarefication, profusion of lung markings, and, in one instance, fluid level.



a

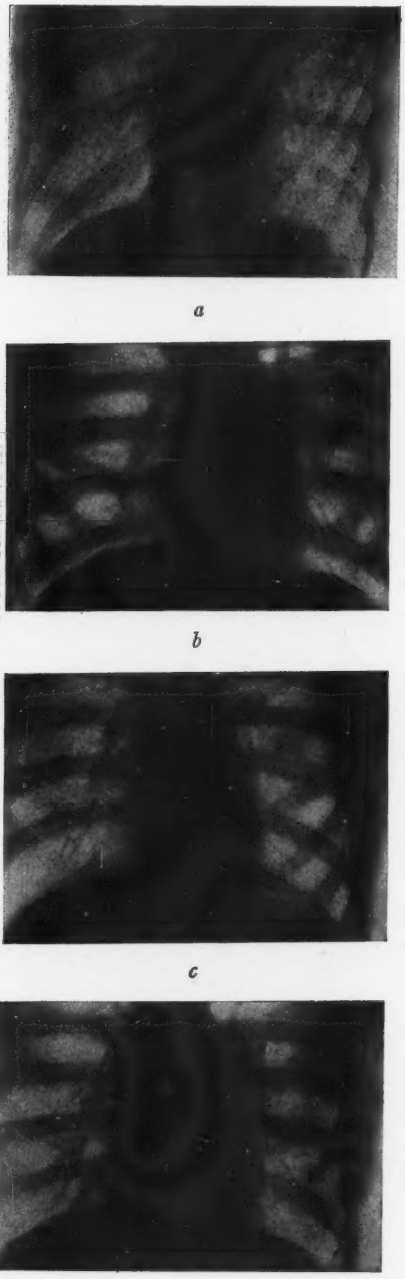
b



c

FIG. 16 (*a*, *b* AND *c*) CASE 4402, SHOWING INCREASE AND DECREASE IN SIZE OF ANNULAR SHADOW

Plates taken about four months apart. Note fluid level in one instance



a

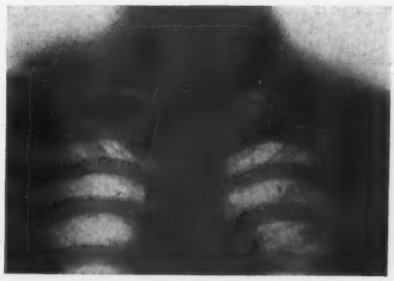
b

c

d

FIG. 17 (*a*, *b*, *c*, AND *d*). CASE 4171 SHOWING DEVELOPMENT, DISAPPEARANCE AND REAPPEARANCE OF ANNULAR SHADOW

a



b

FIG. 18 (*a* AND *b*). CASE 4434. SHOWING COMPLETE DISAPPEARANCE OF ANNULAR SHADOW

Note tag in second plate taken four months later, and absence of mediastinal dislocation and absence of narrowing of interspaces. Also note increased absorption within annular shadow (compare with figure 14).

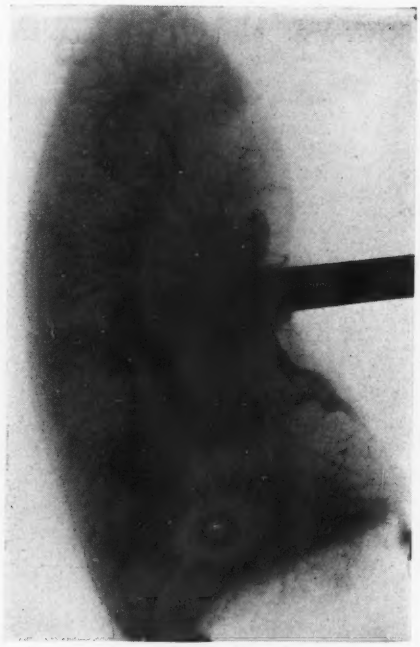


FIG. 19. EXPERIMENTAL ANNULAR SHADOWS PRODUCED BY PLACING RICE PAPER CONSEALS CONTAINING BISMUTH-GLYCERINE MIXTURE IN THE GREATER OR OBLIQUE FISSURE IN AN INFLATED HUMAN LUNG

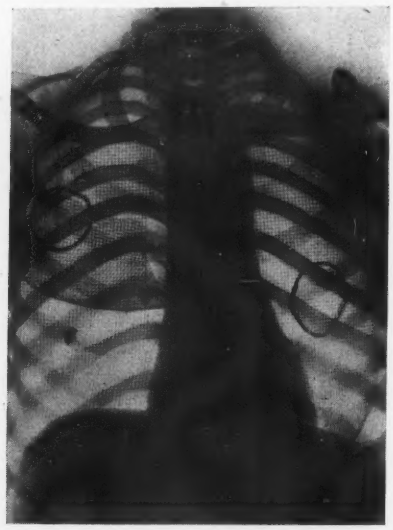


FIG. 20. ROENTGENOGRAM OF BONY THORAX IMBEDDED IN PARAFFINE CONTAINING DIAPHRAGM AND MEDIASTINUM OF THE SAME MATERIAL; AND FISSURE OF WIRE NETTING UPON WHICH ARE PLACED RINGS OF STRING ATTACHED WITH BISMUTH

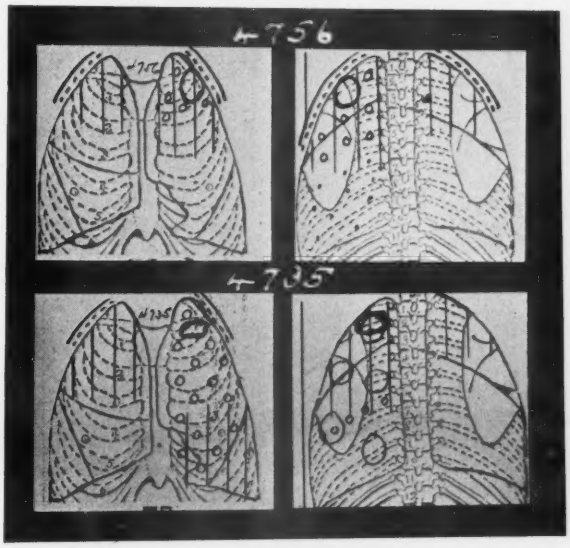
The artificial thorax is the work of Mr. Ben Burger

DIAGRAM OF THE FIFTY CASES WITH ANNULAR SHADOWS WHICH HAVE BEEN STUDIED, SHOWING THE RELATIONS OF THE ANNULAR SHADOWS TO PHYSICAL SIGNS

KEY TO CHARACTERS

Location of Annular Shadow.	Rhonchi.
Fine Rales. Mod. Coarse Rales.	Broncho-vesicular Breathing.
Impaired Note.	Bronchial Breathing.
Dull Note.	Distant Breathing.
Hyperresonant Note.	Vocal Resonance Increased.
	Breathing roughened or Exaggerated.

PTS = Post-tussic suction.
Pect.= Pectoriloquy.
Wint.= Wintrich's Sign.
Bg.Cav.= Breathing Cavernous.
Bg.Amph.= Breathing Amphoric.
Bronch.= Bronchophony



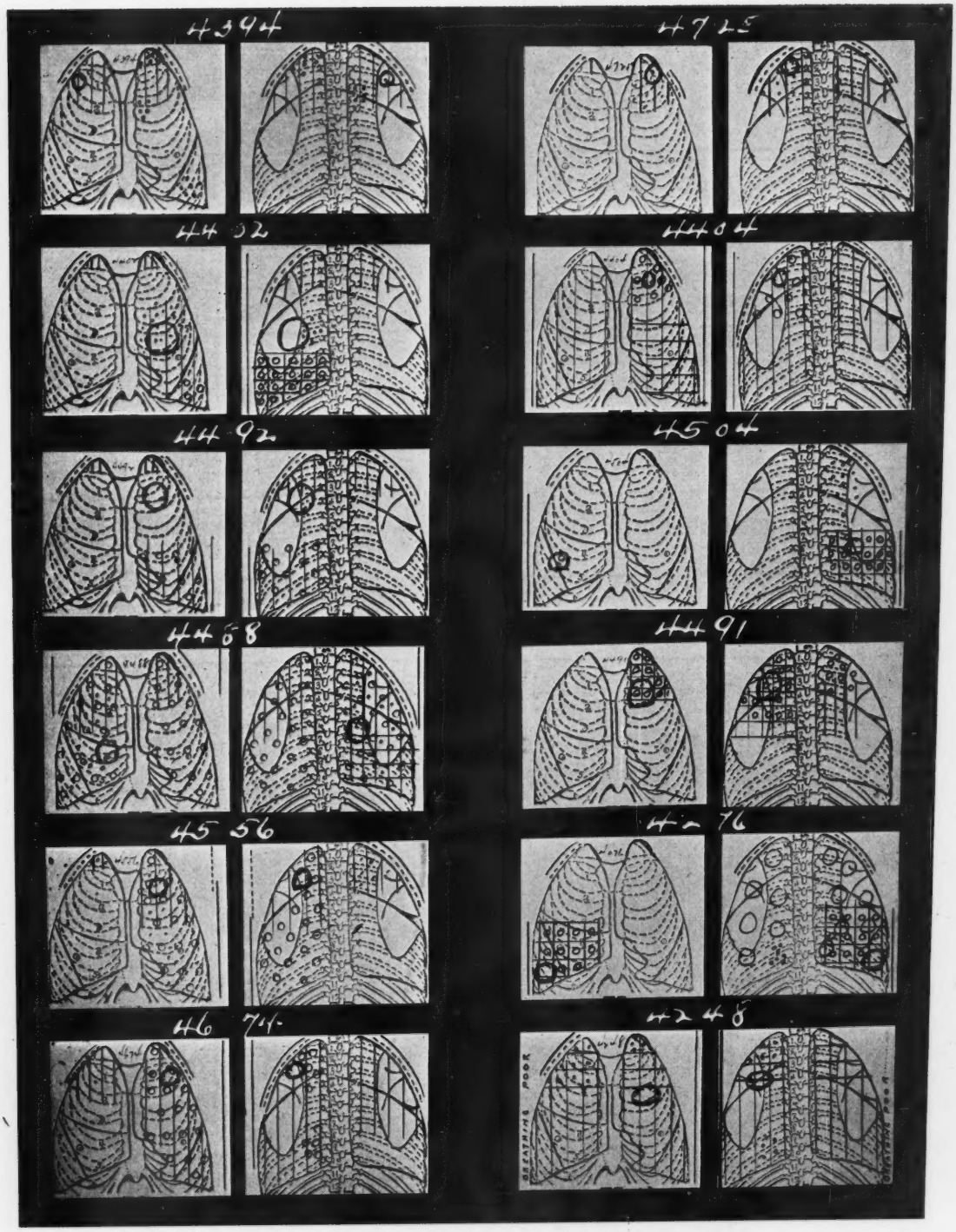


DIAGRAM OF THE FIFTY CASES WITH ANNULAR SHADOWS—*Continued*

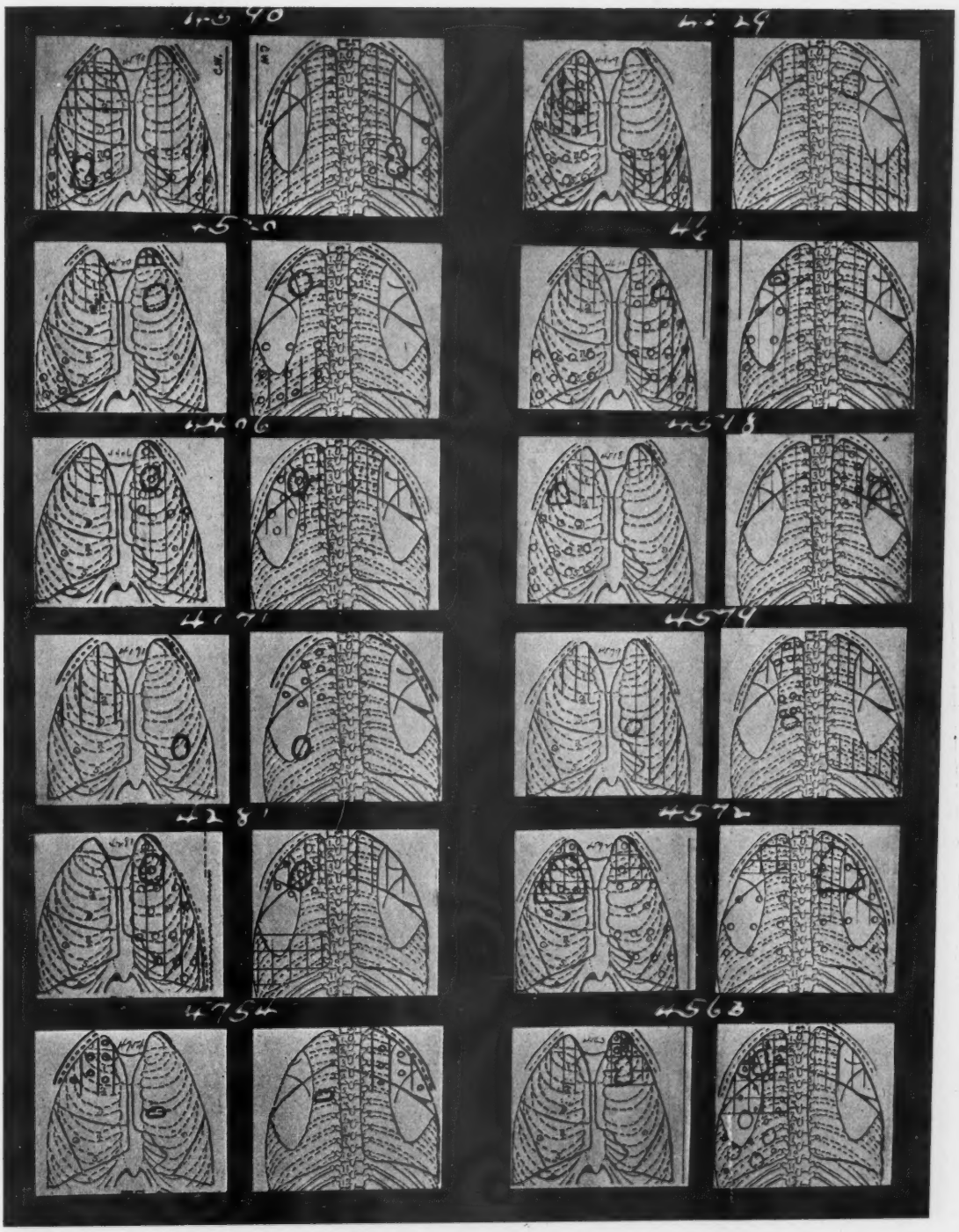


DIAGRAM OF THE FIFTY CASES WITH ANNULAR SHADOWS—*Continued*

DIAGRAM OF THE FIFTY CASES WITH ANNULAR SHADOWS—*Continued*

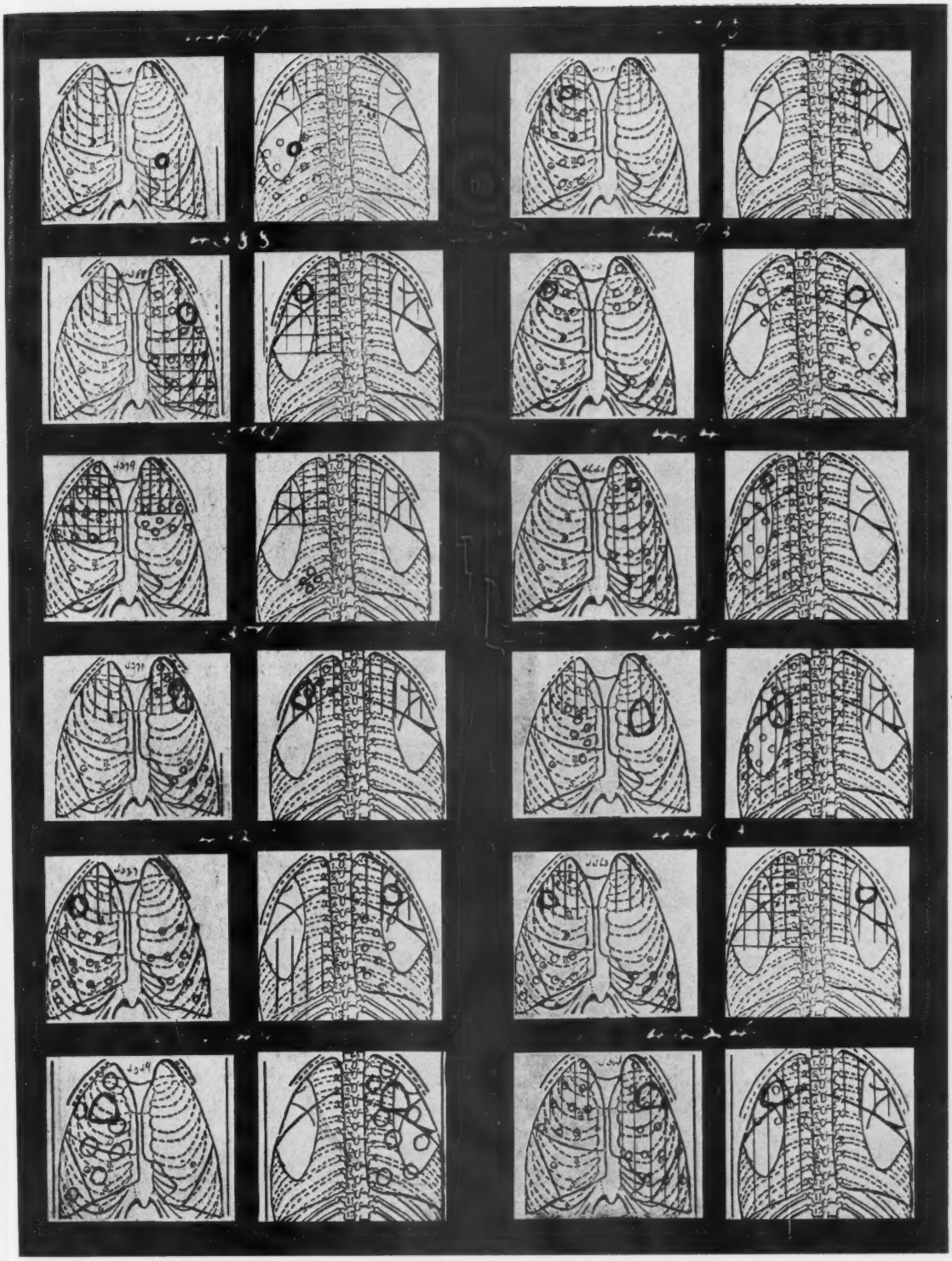


DIAGRAM OF THE FIFTY CASES WITH ANNULAR SHADOWS—*Concluded*

THE TREATMENT OF DIABETES COMPLICATING PULMONARY TUBERCULOSIS BY THE ALLEN FASTING METHOD[1]

H. R. M. LANDIS, ELMER H. FUNK AND C. M. MONTGOMERY

Philadelphia

Although diabetes and tuberculosis have been known since the earliest times, the study of the association of the two diseases is of comparatively recent interest. The credit for the first report of a large number of diabetic cases, with special reference to tuberculosis of the lungs, belongs to Greisinger (1859), who records 250 cases. Windle, in 1883, reported the autopsies of 333 diabetic patients, with mention of the pulmonary conditions. Following Koch's discovery in 1882 tubercle bacilli were found in the sputum and lungs of diabetic patients (1883), and tuberculosis was produced in animals by inoculation with the sputum. Tuberculosis complicating diabetes has even been found in animals. Schindelka reported pulmonary tuberculosis in a diabetic dog, and Berenger-Ferand observed cerebral tuberculosis in a diabetic monkey.

A number of authors have been impressed with certain points of similarity between tuberculosis and diabetes. Thus Sauvage speaks of the interference with nutrition in the two diseases, the abundant elimination of waste products in the urine, both organic and mineral, and the diminished respiratory activity. Shively points to the progressive course in both diseases, to the emaciation, to the great fatality in early life, and the better resistance in later life, to the strong racial affinities, to their greater prevalence in cities than in the country, and to various other conditions common to both tuberculosis and diabetes. Purdy states that the "territories furnishing the highest mortality from diabetes in the United States coincide very closely with those furnishing the highest mortality from consumption. The very frequent termination of diabetes in consumption lends significance to this fact."

[1] Read before the Clinical Section of the Fourteenth Annual Meeting of the National Tuberculosis Association, Boston, Massachusetts, June 8, 1918.

THE FREQUENCY OF TUBERCULOSIS IN DIABETES

In a previous study by one of us (Montgomery) it was pointed out that tuberculosis did not occur more frequently in diabetics than in the general population at the same age periods. Out of 111 cases of diabetes collected in the hospitals of Philadelphia, 9 had active pulmonary tuberculosis and 1 other had adrenal tuberculosis. Out of 51 non-fatal cases of diabetes, none had active pulmonary tuberculosis. Out of 60 fatal cases of diabetes, 9 had active pulmonary tuberculosis and 1 other had adrenal tuberculosis. Out of 35 fatal but non-autopsied cases of diabetes, 3 had active pulmonary tuberculosis. Out of 25 post mortems, 6 showed active pulmonary tuberculosis and 1 tuberculosis of the adrenal gland without tuberculosis elsewhere. Out of 86 non-autopsied cases (35 fatal) 3 had active pulmonary tuberculosis and 17 more had signs recorded that were only slightly suggestive of tuberculosis. Out of 355 autopsies collected from the literature since 1882, including Montgomery's 25 cases, 138 (38.9 per cent) revealed pulmonary tuberculosis mostly in the acute form.

THE FREQUENCY OF DIABETES AND GLYCOSURIA IN TUBERCULOSIS

The occurrence, on the other hand, of diabetes and glycosuria in tuberculosis is as a general proposition considered comparatively infrequent by various writers. Among 31,834 cases of tuberculosis, collected from 25 tuberculosis sanatoria and hospitals in various parts of the United States, there were 101 (about $\frac{1}{3}$ of 1 per cent) cases of glycosuria and 51 (about $\frac{1}{6}$ of 1 per cent) cases of diabetes. Some of the cases classed as glycosurics were undoubtedly diabetics, so that the percentage of diabetics may be assumed to be between $\frac{1}{3}$ and $\frac{1}{6}$ of 1 per cent of all these tuberculous cases. Autopsy statistics vary somewhat as in the following table:

	PULMONARY TUBERCULOSIS	DIABETES MELLITUS
Reports of the Surgeon-General, Public Health and Marine Service, 1895 to 1905	373	0
Henry Phipps Institute until end of 1910	479	1
Jefferson Hospital Tuberculosis Department	110	1
Adami and McCrae: Pulmonary Tuberculosis with Cavity Formation	85	4
	1,047	6

These figures show 6 cases of diabetes among 1047 post mortems. It is possible that Adami and McCrae's cases of diabetes were admitted as diabetics and not as consumptives, as their report is based on general hospital cases and not on cases which are all admitted primarily for their tuberculosis.

CLINICAL ASPECTS OF TUBERCULOSIS IN DIABETES

It is not our purpose to discuss the clinical aspects where these two diseases are associated. There are, however, several points of interest. *Hemoptysis* is stated as relatively rare. Von Noorden noted its occurrence in about 12 per cent of the cases of tuberculosis complicating diabetes. Sandwith did not observe it in any of the cases coming under his notice in Egypt, and Williamson invariably failed to meet with it even in cases observed up until the time of death. Shively, on the other hand, found hemoptysis to be frequent and considerable in amount in 4 out of 6 cases. In the 12 cases herewith reported it occurred in every instance except one. *Tubercle bacilli* in the sputum appear in large numbers, according to Immerman and Rutimeyer, but the majority of writers consider that they occur rarely or not at all (von Noorden). Von Noorden himself failed to find them in 4 open cases with copious sputum, and in a fifth (far advanced) case only after repeated search were a few tubercle bacilli found. In the lungs from this patient the cheesy nodules and their walls revealed masses of tubercle bacilli. Shively in 6 cases found tubercle bacilli present in 3 and absent in 3. In the 12 cases which we have studied the sputum contained tubercle bacilli in 10 instances. In a personal communication McCrae tells us that of 4 cases among his private records, tubercle bacilli were present in all.

TREATMENT OF DIABETES MELLITUS COMPLICATED BY TUBERCULOSIS

The combination of diabetes and tuberculosis in the past was sufficient to render an almost hopeless prognosis. The problem presenting itself was that of one disease requiring dietetic restrictions and the other requiring an abundant diet. The treatment was unsatisfactory because in most instances the tuberculosis was considered paramount and the diabetes less important. We now know that it is vitally important to control the diabetes first of all, at the same time instituting other measures for the tuberculosis, such as rest, etc., as are com-

patible with the diabetic treatment. A renewed interest in the treatment of the two diseases was brought about by Allen's work on diabetes. Allen showed that diabetes was a "specific deficiency of the power of assimilating food" and that there was a lowered functional capacity, not only for assimilating carbohydrates, but also for proteins and fats, and that the object of treatment was the supplying of a diet below the assimilation limit in order that an increase in the tolerance for the various foods might be acquired. In tuberculosis, where so much is dependent upon the ability to take and assimilate a diet of maximum value, the correction of any "specific deficiency in the power of assimilating food" becomes of first importance. We believe that it is absolutely necessary to accomplish this before it is possible to treat the tuberculosis effectively.

It may require considerable courage to make the tuberculosis patient fast for two, three, four or five days and then place him on a restricted diet for weeks afterward. We are encouraged, however, in practising this treatment to see after a while how a previously reduced tolerance for sugars and fats is improved and how the patient, after a preliminary loss of weight, will start to gain on a diet which under previous conditions would have resulted in a still further loss.

Twelve cases of pulmonary tuberculosis associated with diabetes were carefully studied; 10 were males and 2 females. Their ages were 28, 32, 37, 43, 48, 48, 49, 50, 52, 53 and 69 years. One case was incipient, 5 were moderately advanced, and 6 were far advanced. One revealed questionable activity, 3 slight activity, 2 moderate activity, and 6 considerable or marked activity. The prognosis in 6 cases was doubtful and in 6 unfavorable. In 7 of the 12 cases fasting was practiced at the start, in 2 for 5 successive days, in 4 for 3 successive days, and in 1 for 2 days before the urine became sugar free. In all of the cases except one, fast days were ordered at various times during the course of the treatment.

In 5 of the 12 cases the urine could be rendered sugar free on a standard carbohydrate-free diet plus various additions to this diet, including a moderate amount of carbohydrates. These were evidently patients with some carbohydrate tolerance. One patient, however, could be kept sugar free only by ultimately resorting to fasting. Nine of the patients exhibited amelioration in symptoms and the improvement was noted as follows:

1. Weight (+ 10¼ pounds), strength, cough, expectoration, fever.
2. Weight (+ 11¼ pounds), strength, cough, expectoration, fever.
3. Weight (+ 3¾ pounds), strength, cough, expectoration, fever.
4. Weight (+ 1 pound), strength, cough, expectoration, fever.
5. "Felt better."
6. Weight (+ 8 pounds), strength, cough, expectoration, fever.
7. Weight (+ 5 pounds), strength, cough, expectoration, fever.
8. Weight (+ 15 pounds), strength, cough, expectoration, fever.
9. Weight (+ 10 pounds), strength, cough, expectoration, fever.

PHYSICAL SIGNS

In 5 of the 9 cases just mentioned physical signs did not change while the patients were under observation. In one, râles which were not noted on admission became audible at one base. In 3 the number of râles at the apices were considerably reduced. Three of the 12 patients showed progressive tuberculosis, 2 finally dying. There is no evidence of any causative relation between the dietary restriction and the unfavorable course of these 3 cases. As these results stand we can say that it is possible for patients with tuberculosis and diabetes to partake of a considerably restricted diet over a period of some weeks and still show an increase in weight and strength, a fall in temperature, and a lessening of respiratory symptoms. Whether these results in our cases would have been still more favorable on a more generous diet, or whether the progressive cases owe their failing health in any measure to the dietary limitations, cannot be stated. Nor has it been determined whether the reduction in the amount of sugar in these cases has had any effect on the pulmonary process. Other conditions being equal, we feel that prompt treatment of the diabetes according to the method of Allen offers the tuberculosis patient the best chance in the ultimate effort to control the tuberculosis. This is well illustrated by reference to the following case histories:

A. M., male, age forty-one, admitted to the White Haven Sanatorium December 5, 1916.

Family History. Mother died at sixty-nine years of age of diabetic gangrene.

Personal History. Fifteen years ago had hemorrhages from the lungs, for which he was sent to Colorado, where after a short time he gained in weight and became free from symptoms. Since that time he has had numerous attacks of blood spitting, and some years ago was told by a doctor that he

had sugar in the urine. Within the past two months he has developed a frequent productive cough, pronounced weakness, chilliness and fever, and loss of weight from 190 to 160 pounds. Upon admission he was quite sick, chilly and spitting blood.

Physical examination. There were signs referable to the upper right lung. There were abundant crackling râles at the right apex and a few at the left apex. The sputum showed tubercle bacilli. The urine on four successive days varied in its specific gravity from 1035 to 1040, and showed sugar in amounts from 3.4 to 4.6 per cent and a faint reaction for diacetic acid.

Treatment. The patient was placed at rest in bed in the open and on the regular house diet to determine the degree of glycosuria. He was then fasted for two days before he became sugar free, when he was given 200 gms. of 5 per cent greens. Subsequently the diet was increased, as per the attached chart. During the administration of the treatment hemorrhages occurred and continued almost daily in varying amounts up to 9 ounces, until after a period of approximately two weeks it was deemed imperative to induce pneumothorax when a sudden cessation followed. The subsequent course of the tuberculosis and diabetes was favorable, as is well shown in the attached weight, temperature and other charts. Shortly before discharge, which was demanded because he felt so well, the patient indulged in several dietetic indiscretions with a consequent derangement again of the sugar tolerance. We feel confident that in this particular case if the patient had remained under treatment sufficiently long and with acquiescence to the dietetic restrictions, he could subsequently have reached a point where with a fairly liberal diet he would have made further gains in weight, remained sugar free, and continued to arrest more and more the tuberculous lesion. It was most interesting to observe the results of treatment in this patient which was instituted in the presence of recurring pulmonary hemorrhages that ultimately required therapeutic pneumothorax.

S. H., female, age forty-three came under observation in our private practice on November 10, 1917.

Family History. Mother died of tuberculosis.

Personal History. Patient has coughed for many years and spat blood several years ago. Recently, that is during the last three or four months, she has lost weight in spite of an unusually good appetite and digestion. Her average weight is 145 pounds, present weight 125 pounds. Her cough has become aggravated and associated with expectoration. Coincident with the loss of weight there has been pronounced weakness with an afternoon fever of 99.4 to 100°F.

Physical Examination revealed an old chronic tuberculosis with infiltration of the upper portions of both lungs. The sputum contained tubercle bacilli. The urine showed a marked reaction for sugar when 5 to 8 drops were added to 5 cc. of Fehling's solution.

Treatment. The patient was placed at rest in bed and fasted for three days, when the urine became sugar free. The patient was then placed on 200 grams 5 per cent greens and the diet gradually increased until a tolerance of 160 grams carbohydrate was reached, beyond which it was not possible to go without developing glycosuria. At the end of three weeks the temperature became more normal, and the cough lessened, but the weight dropped 8 pounds to 117 pounds. Subsequently, however, there was a gradual improvement, until in January the patient weighed 130 pounds, and on April 10th, 132 pounds. Coincident with the general improvement of the patient there was a marked improvement in the local symptoms and signs, and when last seen the patient was on three hours' exercise.

M. Y., female, age forty-two, admitted to the White Haven Sanatorium October 23, 1917.

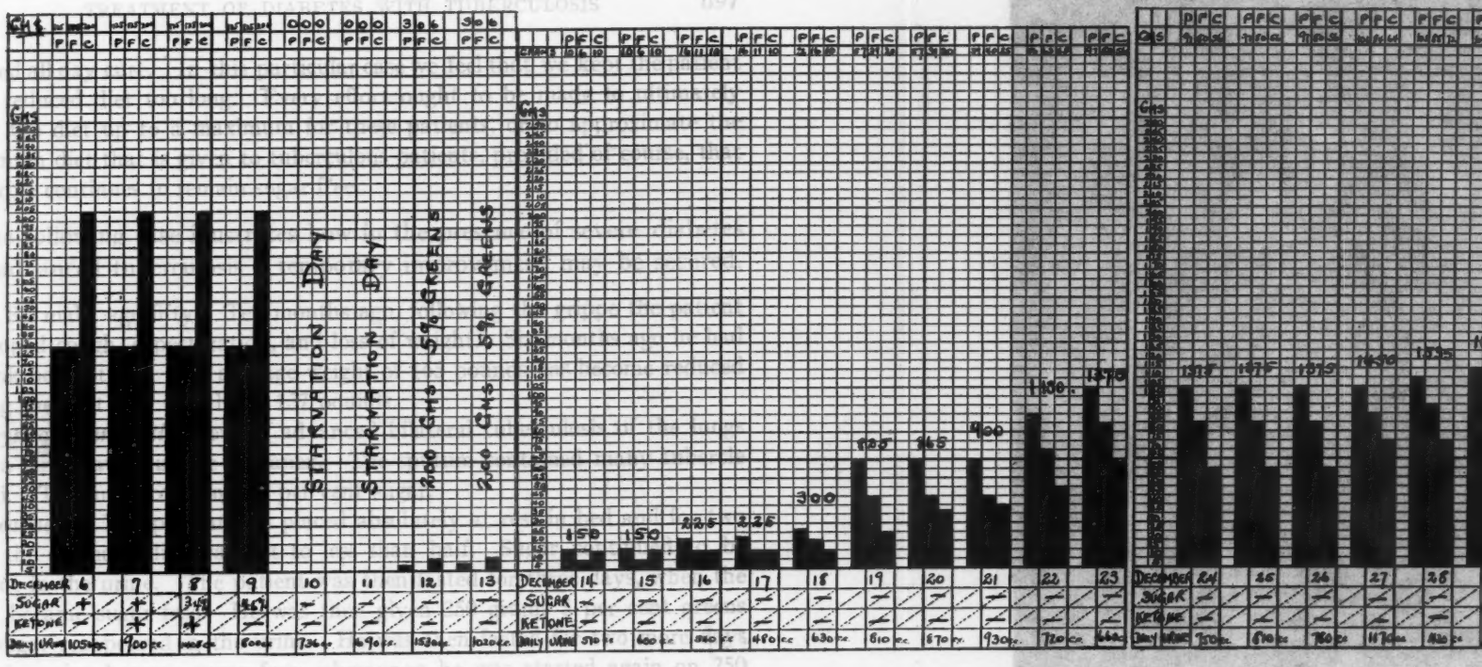
Family history. Father died at sixty-five years of age of pleurisy. Mother died at seventy-five years of age of pneumonia.

Present illness dates from a cold in June, 1917, since which time she has had a constant cough and expectoration with progressive loss of weight. One hemoptysis occurred in September, 1917. During the last three months she has had considerable dyspnea at times, and without exertion. The appetite is poor; the bowels are constipated. She weighed 200 pounds in June, 1917, and upon admission in October, 1917, 157 pounds, a loss of 43 pounds in four months. During the past month at home she has felt quite sick and unable to do ordinary housework.

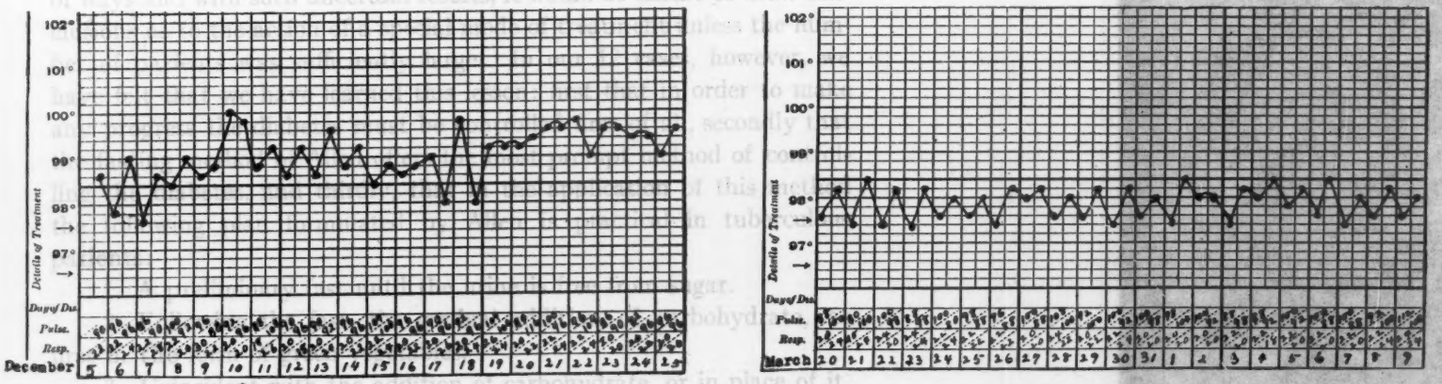
Physical examination reveals a pallid adult female who appears quite sick. The lung examination reveals bilateral tuberculous disease with extensive involvement of the left side where the signs are those of consolidation of the entire upper lobe. The right lung shows signs of infiltration at the apex. The heart is normal. The sputum shows many tubercle bacilli. The urine contains 4.3 per cent sugar and a trace of acetone and diacetic acid.

Treatment. After three days of fasting the urine became sugar free, whereupon the patient was started on a diet containing 200 grams of 5 per cent greens. The diet was subsequently increased in the same manner and to the same level approximately, as in the case of A. M., whose chart is appended to this article.

In spite of the fact that she was kept sugar free by this diet and an occasional fast day, she progressively lost in weight to 118 pounds. The tuberculosis seemed stationary, as far as physical signs were concerned, and the constant dropping off in weight, with the marked weakness, lead us to believe that we ought to increase her diet. This we did, with the result that she promptly gained about 15 pounds in a period of two months so that she now weighs in the neighborhood of 130 pounds, the urine continuing sugar free. She is now (December 30, 1918) considerably stronger, is afebrile and is



TEMPERATURE CHART



CHARTS OF PATIENT A. M., SHOWING DIET, TEMPERATURE, WEIGHT, AND HEMORRHAGE RECORD. IN THE DIET CHART THE FIGURES BELOW THE COLUMNS REPRESENT THE CALORIC
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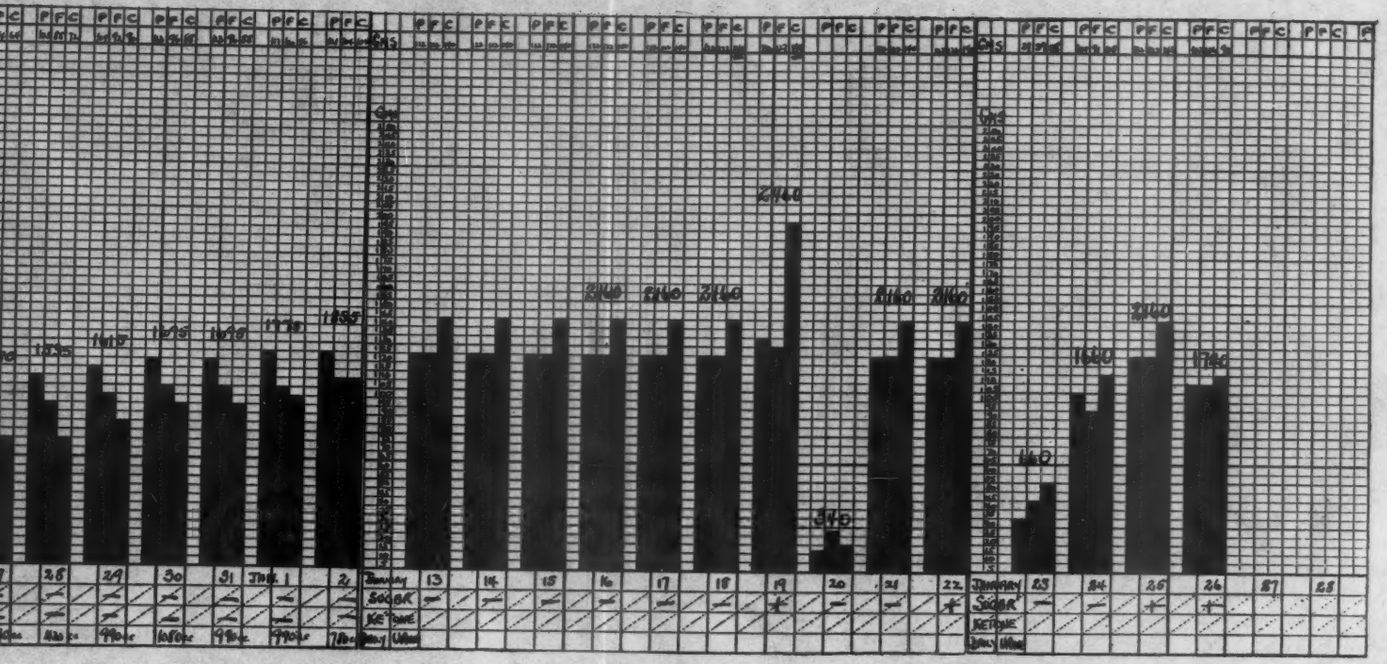
CHART

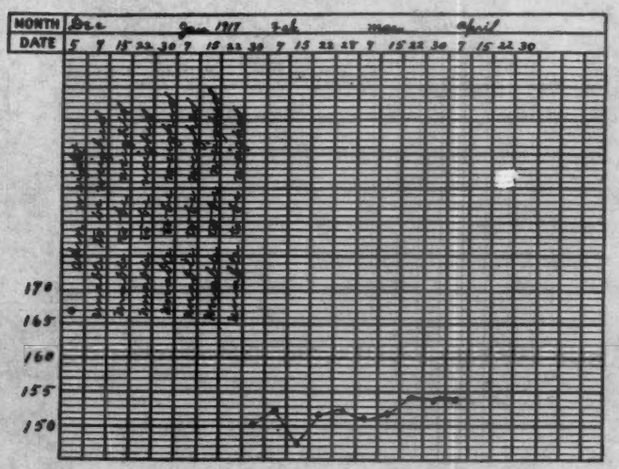


WHITE HAVEN SANATORIUM
WHITE HAVEN, PA.

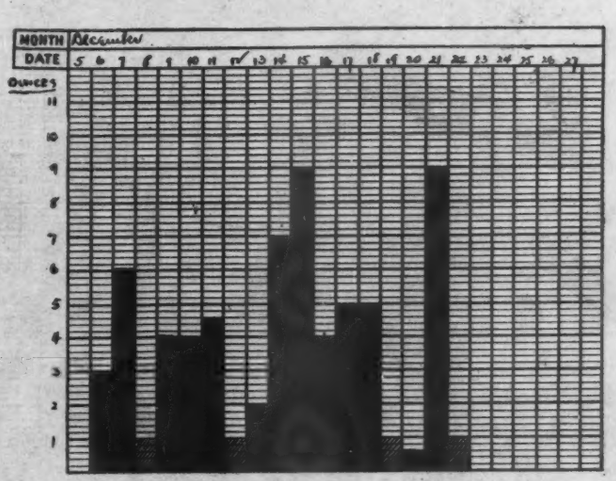
WEIGHT CHART

Name Abe miller Admitted 12-5 1916

Y.P. Dr. Landis
Corp T. Dept M
#4621
Highest Weight 205
Average Weight 190
Lowest Weight 175



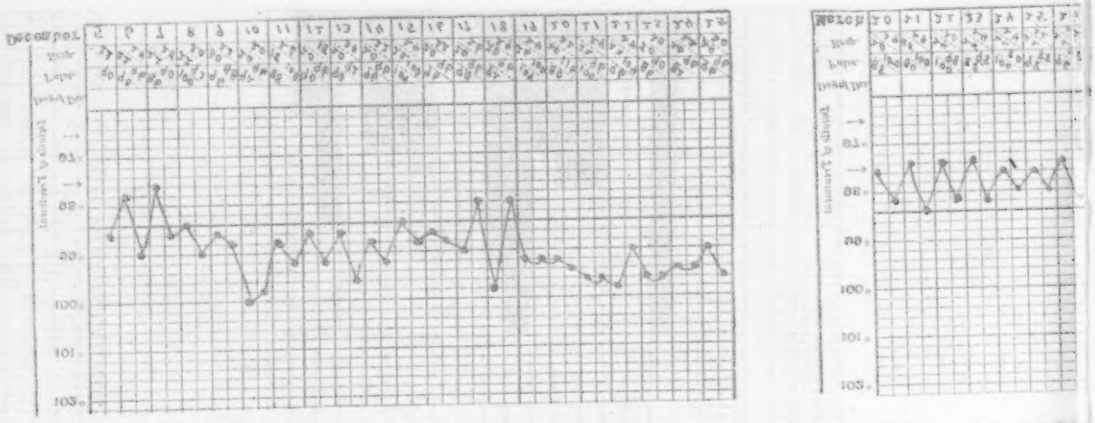
HEMORRHAGE CHART



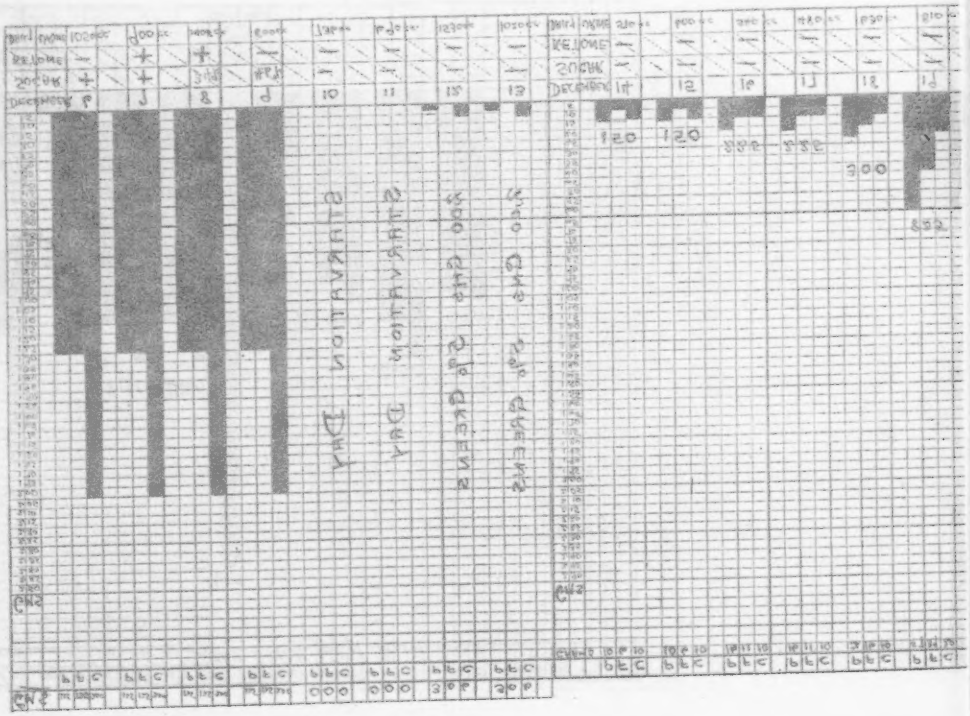
E CALORIC VALUE OF THE DIET FOR THE DAY. IN THE HEMORRHAGE CHART THE SOLID COLUMNS REPRESENT THE AMOUNT OF BLOOD, THE SHADED COLUMNS SSATION OF THE HEMORRHAGES AS DEPICTED IN THE CHART FOLLOWED THERAPEUTIC PNEUMOTHORAX.

CHART OF PATIENT A. M., SHOWING DIET, TEMPERATURE, WEIGHT, AND HEMOGLOBIN RECORD. IN THE DIET C

THE AMOUNT OF STARCHED PORTION ON WHICH PA



TEMPERATURE CHA



allowed all day cure. In this particular case we feel that we kept the patient on a reduced diet too long. Every effort ought to be made to ultimately bring the diet up to a maximum for these patients, or to approximate the maximum diet that is given to tuberculous patients, provided of course, that the urine continues to remain sugar free.

The following case illustrates how in the presence of severe diabetes and advanced tuberculosis a temporary improvement may be secured.

C. B., male, age fifty. Ten months ago, following the grippe the patient developed cough, expectoration, and loss of weight. Six months ago he had a frank hemoptysis. His average weight of 165 pounds has become reduced during the past four months to 137 pounds.

Physical examination reveals advanced bilateral tuberculosis of the lungs with a large cavity in the left apex. The sputum contained many tubercle bacilli. The urine contained 5 per cent sugar.

Treatment. The patient was placed absolutely at rest in bed and for two days the ordinary diet was cut to less than half. Sugar continued to be present in the urine. The patient was then fasted for three days, when the urine became sugar free. He was then given 250 grams 5 per cent greens and sugar reappeared in the urine. He was then fasted for two more days and the urine became sugar free, whereupon he was started again on 250 grams of 5 per cent greens, and by the gradual addition of 5 grams carbohydrate every other day, his tolerance was gradually raised to 75 grams. The symptoms referable to his tuberculosis were for a time definitely improved, although subsequently, as a result of the extensive lesion, the disease again became quite active.

In a disease like tuberculosis which affects its victims in such a variety of ways and with such uncertain results, it would be unsafe to draw conclusions as to the action of a special mode of treatment unless the number of patients was sufficiently large. In our 12 cases, however, we have felt that we have learned this lesson: first that in order to make any progress the diabetes must be controlled first of all, secondly that the fasting method of Allen offers the most prompt method of controlling the diabetes, and thirdly, that in the application of this method the following plan formulated by Allen is practical in tuberculous patients:

1. A preliminary fast until the urine is free from sugar.
2. Following the fast, the gradual addition of carbohydrate, at first in the form of green vegetables.
3. Coincident with the addition of carbohydrate, or in place of it,

if the carbohydrate tolerance is very low, the addition of protein to the diet in small but gradually increasing amounts until glycosuria occurs, or a sufficient amount of protein is taken to cover the basal requirement.

4. The addition of fats in small amounts during the time of addition of carbohydrates and protein. Subsequently, a sufficient amount of fat is added to make up the fuel requirements of the body, provided this amount can be tolerated without the appearance of glycosuria or acidosis.

5. Frequent urine examinations are made, either by the physician or by the patient himself, and the appearance of sugar is taken as an indication for a fast of sufficient length to cause a cessation of the glycosuria. Feeding is subsequently begun with not more than one-half of the carbohydrate contained in the diet at the time of the appearance of glycosuria. The subsequent carbohydrate increase is made very gradually.

6. At intervals, the patient is fasted for a day or else takes a greatly restricted diet.

Rest in bed, rather than exercise, as is advised in ordinary diabetics is necessary because of the tuberculosis; and special care is necessary in order not to increase the fats too rapidly in the desire to bring up the caloric value of the diet, for fear of producing acidosis, as in several of our cases. The treatment is applicable in the presence of recurring hemoptysis, and in every case of tuberculosis of the lungs unless the patient is obviously hopelessly ill with the pulmonary lesion, in which case, the institution of the antidiabetic treatment would add only further discomfort.

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THE TREATMENT OF LARYNGEAL TUBERCULOSIS BY REFLECTED CONDENSED SUNLIGHT

CHARLES W. MILLS AND ALEXIUS M. FORSTER

Colorado Springs, Colorado

The revival in recent years of the treatment of tuberculosis by heliotherapy and the success attained by the method in various forms of the disease, especially in the bone and joint and skin varieties, have naturally led to attempts to apply sunlight to the diseased larynx.

These attempts, as will be seen by a review of the literature, have met with a fair degree of success. At first the light was applied externally to the neck, but in 1904 Josef Sorgo (1), physician in chief of the Alland Sanatorium at Davos, devised a system of mirrors for the purpose of reflecting the rays of the sun directly upon the larynx. In the following year, Sorgo's assistant, Kunwald (2) described Sorgo's method in more detail and reported a series of 14 cases treated with encouraging results.

Sorgo's method was simple but crude. The patient sat with his back to the sun and held an ordinary hand mirror so as to reflect the sunlight upon a laryngeal mirror held in position in the mouth. The same mirror was used for the reflection of the rays, and for the observation of the throat by the patient, an obviously difficult arrangement.

Following Sorgo and Kunwald the method was used to some extent in Switzerland and Germany, and later in France. Articles by Janssen (30) and by Kraus (31) in 1909 describe improvements in Sorgo's apparatus made by substituting a mirror attached to an adjustable stand for the hand mirror. This of course made it easier for the patient to throw a steady stream of light upon the larynx. Janssen also mentions the possibility of increasing the intensity of the light by the use of a concave mirror instead of a plane one, but believes that the increased heating and consequent hyperaemia of the laryngeal tissues obtained by the concave mirror are objections to its use. The hyperaemia prevents the absorption of the shorter or ultraviolet rays of the spectrum, which are the ones desired for therapeutic effect.

Sorgo had previously attempted to obviate the effect of the heat rays by use of a water filter, and also by spraying the throat with adrenalin before applying the light.

In 1909 Tilmann (34) of Stockholm reviewed the previous literature quoting about two dozen publications and reported the cases of 4 of his own patients in his sanatorium at Osterosen. His conclusion is that heliotherapy of the larynx is a simple and harmless treatment, effective when the weather conditions are favorable and free from the slightest untoward effects.

In 1910 Brünings and Albrecht (35) tried the effect of sunlight on experimentally produced tuberculosis of the larynx in rabbits, and could not find that there was any tendency toward repair under the influence of the radiation.

In 1912 Collet (37) in the Lyon Medicale, reported very encouraging results. His first patient treated in this way in 1905 has been permanently cured for six years to date. Collet's method differed somewhat from that of Sorgo's and his successors. Collet's patient sat facing the sun, wearing a broad black hat and black spectacles. The sun was allowed to shine directly upon the laryngeal mirror held in the throat. A hand mirror was used by the patient for observing the result. The sunlight was applied at intervals during the day, the total application amounting to from a half to a full hour daily. In six weeks the improvement was marked and by the end of seven months there was scarcely a trace of laryngeal infection. In a second case, two hour exposures during the day were made with equally favorable outcome, and in a third case, marked improvement was realized in a few weeks.

A year later Lavielle (38) modified Collet's method by using a straight tube, 25 cm. long, for directing the light upon the laryngeal mirror. He believed that with the use of this apparatus the duration of the treatments was lessened and the therapeutic value of the insolation heightened.

In 1913 Blumenthal (39) of Berlin reported the result of direct sunlight treatment upon a larynx which had been opened by the operation of laryngo-fissure. Treatments of ten minutes duration were given daily for three weeks with no result.

In 1914 Sari (40) reported 6 cases treated by Collet's method and concluded that primary laryngeal tuberculosis yields fairly easily to heliotherapy; that even when lesions are somewhat extensive they may become reduced if the patient's general health is good; but that old and aggravated cases cannot receive benefit from the treatment.

In 1914 Leon Philip (43) chose the subject for his thesis at the University of Lyon. He improved Sorgo's method, using a system of three mirrors, a concave reflector which receives the sunlight and reflects it upon the small laryngeal mirror, and in addition a plane mirror for observing and controlling the flow of light into the larynx. Philip reported 14 cases treated by this method, all but one of whom received benefit.

A more complete bibliography will be found at the end of this article.

In the present paper we desire to report further improvements in the method of heliotherapy in laryngeal tuberculosis, improvements which we believe add considerably to its value as a means of treatment.

The credit for these improvements belong principally to a former patient, Mr. Frank Verba, of Colorado Springs, who ingeniously worked out his ideas in connection with the treatment and cure of his own seriously diseased throat. At the suggestion of one of us (Forster) Mr. Verba, then a patient at Cragmor Sanatorium, began the application of sunlight to his own throat, following at first the methods reviewed above, that is, the use of a plane glass hand mirror, and a glass laryngeal mirror.

Mr. Verba soon experimented with a concave mirror, using for the purpose a laryngologist's head mirror, and found that the condensed light obtained by its use had a distinct effect in easing the pain in his throat. Becoming more interested in the subject, Mr. Verba began to study the physical properties of different reflective substances, and it soon became clear that glass was by no means the ideal substance for the purpose, inasmuch as it absorbs a very high percentage of the shorter spectral rays, especially the ultraviolet rays, and lengthens many of the light rays into heat rays. It has been demonstrated by numerous experiments in the use of heliotherapy, that the ultraviolet or actinic rays of the spectrum are the ones that produce the beneficial results. These are the chemical rays, the ones that cause tanning of the skin, and that have a bactericidal action.

To overcome this difficulty in the use of glass mirrors, Mr. Verba, in 1915, with the help of Professor Tileston of the physics department of Colorado College, carried out a series of experiments with various reflecting substances, finally selecting, as most efficient, a metallic alloy of aluminum and magnesium.[1]

[1] Mr. Verba also received valuable suggestions and information from Professor Shearer of Cornell, Professor Kester of the University of Kansas, Professor Wilcox of the Armour Institute of Technology, and the Landolt-Börnstein-Meyerhoffer "Tabellen."

It was found that this alloy would reflect a very high percentage of the ultraviolet rays and at the same time absorb many of the heat rays, just the reverse of glass mirrors. This substitution of metallic for glass mirrors also removed the objection made by Janssen to the use of a concave mirror, that the concentration of heat rays produced a harmful hyperaemia.

Fig. 1

Sunlight strikes composition reflector, "A" where it is condensed and projected onto composition laryngeal reflector, "G", thence into larynx. The image of larynx returns to observation mirror, "B", and then to the eye.

The use of a concave mirror of course permits the throwing of a concentrated and much more powerful beam of light upon the larynx. If this condensed light can be composed of the shorter wave lengths, as is the case with the metallic reflectors, the therapeutic effect is thus enhanced by the use of a stronger light. The exposures can be considerably shortened, much to the patient's comfort.

The apparatus which we have used, following the modifications introduced by Mr. Verba, is shown in fig. 1. The patient sits with his back to the sun. The sunlight is first reflected from a concave metallic mirror into the mouth of the patient, and upon a metallic laryngeal mirror held in proper position in the throat. A glass mirror is used to view the larynx, for the purpose of observing that the light is being properly directed. Both the metallic condensing mirror and the glass observation mirror are attached by adjustable joints and supports to a frame, which can be conveniently attached to the back of an ordinary chair placed in front of the patient. The patient will usually find it necessary to hold the tongue forward with a gauze handkerchief and must also have a glass of hot water at hand for heating the laryngeal mirror, exactly as in ordinary laryngoscopic work. After a little practice most patients readily learn to observe their own larynges and to direct the light upon the lesions.

At first, as in other affections treated by heliotherapy, very short exposures are made. The time is then gradually increased. Usually at the start, we have used an exposure of only thirty seconds daily; gradually increasing to a maximum total of ten minutes or, in a few cases, twenty minutes once or twice a day. At the end of the period of exposure there is observed a certain amount of hyperaemia, which disappears in a few hours. No pain is experienced; in fact the method appears to have an analgesic effect on painful lesions.

Under the use of this method we have seen in some cases obstinate ulcers heal, infiltrations subside, painful lesions become painless—in fact a steady cleaning up and healing of tuberculous laryngeal lesions. We have not noted any bad effects from the use of this method. Occasionally at the beginning of treatment, we have seen infiltrations break down into small ulcerations, which then proceeded to heal under continued use of the light. This effect seems to be analogous to that of the X-ray on tuberculous glands. The first effect of the X-ray on glands in which softening has not taken place is often to produce a softening. The necrotic material can then be aspirated and the glands heal. The effect of the sunlight rays on laryngeal lesions would appear to us to be very similar. This breaking down of infiltration is not at all constant for we have seen it in only two cases. In most cases the infiltrations have subsided gradually without breaking down.

Altogether we have personally observed seven cases of laryngeal tuberculosis treated at Cragmor Sanatorium by this method and with

the apparaus described. The method has been used to some extent by other physicians of Colorado Springs and vicinity, in many cases with encouraging results.

CASE REPORTS

A brief report of our seven cases follows:

1. Man, age 32. Advanced pulmonary lesions. Extensive infiltration and ulceration of laryngeal wall, arytenoids and epiglottis, which had resisted the usual methods of treatment. The lesions healed completely under the influence of sunlight, the whole course of treatment lasting about a year.
2. Man, age 36. Ulcerations of the larynx, gums and roof of mouth. These healed under the influence of sunlight in about six months.
3. Woman, age 36. Small apical pulmonary lesion. Small superficial ulcer on posterior wall of larynx. This healed in a few weeks under rest of the voice and sunlight without any local application. Subsequently after treatment had been discontinued it broke down again.
4. Woman, age 26. Advanced pulmonary lesion. Slight infiltration of the posterior commissure, and recurrent paralysis of the left cord. Under rest, sunlight, and occasional local treatments, the infiltration disappeared completely in about three months. As would be expected no effect was observed on the paralyzed cord.
5. Man, aged 23. Advanced pulmonary lesions. Infiltration of arytenoids, posterior wall and cords. Considerable improvement took place during the three months that the patient was under treatment.
6. Man, age 40. Advanced pulmonary lesions. A rather acute laryngitis, with congestion of all the tissues, infiltration of the posterior wall and arytenoids, relaxation of the left cord. Was treated for four months by rest and local applications without much noticeable result. Heliotherapy was then added to these other methods and in the ensuing four months there has been marked lessening of the infiltration and improvement in the appearance of the tissues.
7. Woman, age 30. Advanced pulmonary lesions. Spot of infiltration and small ulcer on posterior wall of larynx. Has been taking sunlight treatment for three months, too short a time for a definite report, but the lesion appears to be improving.

Finally, while we realize that the number of cases observed is too small to draw definite conclusions, yet the results obtained have been so encourgaging that we feel that the method warrants a more extended trial.

We also feel that the use of a metallic in place of a glass condensing mirror is a very definite improvement over previous methods, and that our more favorable results as compared with previous observers, are to be attributed to its use.

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PULMONARY CONDITIONS SIMULATING TUBERCULOSIS

JABEZ H. ELLIOTT

Lieutenant-Colonel, C. A. M. C., Toronto

In the discharge of duties assigned to me as visiting physician to a number of military hospitals and with special reference to work in diseases of the chest in a large military district, it has fallen to me to advise as to the disposition of a large number of cases of pulmonary disease. During the first year of this work, 25 or 30 men were referred each week, while for the past two years the number has steadily grown until at present about 100 are seen each week.

These comprise all classes of pulmonary disease, and include wounds and injuries to the chest. Their origin is various. They come from depots and camp hospitals, from base hospitals or from special hospitals within the district, while a large portion are invalided overseas men returning for further treatment or for disposition.

The cases which will be of special interest to this section are those who arrive in our clearing hospital for disposition and whose papers bear the diagnosis, either pulmonary tuberculosis, tuberculosis clinical or tuberculosis suspect. In the British hospitals and services, the diagnosis of pulmonary tuberculosis or phthisis is not made until tubercle bacilli have been demonstrated in the sputum, so that this diagnosis indicates the patient is, or has been, while in hospital, an open pulmonary case. Clinical tuberculosis is applied to those whose physical signs or symptoms or both, point clearly to a diagnosis of tuberculosis of the lung, but in whom sputum examination has failed to reveal acid fast bacilli.

The third group, tuberculosis suspect, is more difficult to define, but as the name indicates, will include all cases in whom the symptoms may suggest tuberculosis and in whom no other diagnosis has been made which will explain these symptoms. Included in this group, are those cases of bone, gland, abdominal and genito-urinary tuberculosis that are referred to the division of respiratory disease for an expression of opinion as to whether there is any co-existing pulmonary lesion.

PULMONARY TUBERCULOSIS, PHTHISIS

Of this class little need be said. The finding of the tubercle bacillus is an essential for this diagnosis to be made, and with definite physical findings or symptoms, mistakes can rarely occur. But precaution, however, is always to be observed. There is no question but that cases have occurred in which men with bronchitis or other disease of the respiratory organs accompanied by cough and sputum, have been known to submit sputum not their own and known to contain tubercle bacilli, for the purpose of securing further period in hospital or to enhance their expected pension.

TUBERCULOSIS CLINICAL, TUBERCULOSIS SUSPECT

I wish to speak to-day more particularly of the two classes, tuberculosis clinical and tuberculosis suspect. First of all let me express myself, that it is most important that an absolute diagnosis be made before the final disposition of the case; that is, before a man is admitted to a sanatorium for treatment, it shall be decided whether or not he is suffering from pulmonary tuberculosis, and that before a man is discharged from the service, it shall be decided whether he is, or is not, suffering from tuberculosis, or from an aggravation by service of an old tuberculosis.

I maintain strongly that it is unfair to send to a sanatorium any non-tuberculosis case. True enough, almost any pulmonary invalid requiring medical care and treatment will do well in a sanatorium, but it is unfair to his family and unfair to himself, that after discharge from the army it can be said he was treated in a sanatorium. No matter what statement may be made, this is bound to interfere with his getting insurance later, while during the time he is in the sanatorium any member of his family may find difficulty in securing insurance. After discharge it will be held against him in his attempt to secure employment. From the present state of public opinion there is no doubt in my mind but that we should have special hospitals for treatment of non-tuberculous pulmonary cases, and we have no more sanatorium directors and experts than are required for the care of our definitely tuberculous.

It is unfair to discharge any man from the army as a tuberculosis suspect. A man either has or has not a pensionable disability due to tuberculosis and every method at our disposal for the purpose of diag-

nosis is to be used in an attempt to arrive at a definite diagnosis, rather than to send a man out into civil life, tagged tuberculous, and giving him a pension based thereon. It may be said that a man should be given the benefit of the doubt and should receive the higher pension carried by the diagnosis of tuberculosis instead of the one which will be given in the case of debility. Why be in doubt? It is unfair to diagnose tuberculosis if a man is not suffering therefrom. It is not a question whether a man is tuberculous. All of us have been infected. A man's pensionable disability is based upon whether he is suffering from tuberculosis or the effects of tuberculosis. I think we to-day should take the stand that a man who makes the diagnosis of tuberculosis must adduce the proof.

IMPORTANCE OF DIAGNOSIS

In December, 1915, after a little more than a year of war, Professor Landouzy announced that already 86,000 men had been discharged from the French army on account of tuberculosis. Hermann Biggs, with this fact as a text, sought to rouse the American people to a proper sense of danger. Then came Major Rist of the French army, to tell us that of the 86,000, there were, when diagnosis was better made, only one-fifth positively tuberculous. The French army, as Bushnell says, lost the services of two divisions of men at a time of urgent need, simply on account of wrong diagnosis. In Canada, Stewart of the Ninette Sanatorium states that of soldiers returned to his military district as tuberculous, nearly 28 per cent were re-classified as negative and five per cent as doubtful. With special care and attention to this class of case, the percentage of negative and doubtful has steadily risen from 12 per cent in the first 50 cases, to 50 per cent in the last 50 observed. He states also, that from the literature he learns Fraenkel found 60 per cent, de LaCamp 30 per cent and Blimel 80 per cent non-tuberculous.

Parfitt has recorded that in a group of returned men sent to him for treatment for tuberculosis, or suspect tuberculosis, he considered that only 60 per cent could reasonably be said to be tuberculous, and of these tubercle bacilli were found in the sputum of only one-third. Parfitt also quotes Osler as considering only half of such cases seen in England proved to be tuberculous.

There is no doubt that 60 to 80 per cent of the cases returned from overseas as tuberculosis suspect must be classified as not suffering from tuberculosis.

It is then important that the diagnosis of tuberculosis be made absolute if at all possible, while the man is overseas, for having once returned as a tuberculosis suspect, he is practically lost to the army.

An attempt to classify the various conditions which have led to the diagnosis of tuberculosis suspect, will perhaps make the subject more clear.

There are certain cases in which the diagnosis has been made from symptoms rather than physical signs. These will include notably hyperthyroidism, chronic appendicitis, certain cardiac and nephritic diseases, malnutrition from any cause. The flabby hypotonic man is constantly being referred for examination for the presence of tuberculosis, as is the debilitated patient who is anemic and who has a bronchitis which is difficult to get rid of. The discussion of these various cases would perhaps be interesting, but I wish to speak especially of those whose symptoms and physical signs are more particularly referable to the respiratory system.

1. INTRANASAL COMPLICATIONS

Considering them systematically, the first will be those whose pulmonary symptoms are secondary to intranasal complications.

Pathological conditions of the nose and throat and sinuses do produce symptoms simulating pulmonary tuberculosis. No examination of a suspected case with cough is complete without a report from the nose and throat department. Again and again we see the pulmonary symptoms clear up completely after intranasal treatment. We have seen many such cases whose debility, cough and basal râles have quite cleared after removal of diseased tonsils or adenoids, drainage of the antrum or sinuses, removal of polypi or other treatment of the upper respiratory tract. Usually the signs and symptoms clear up promptly; in other cases slowly.

2. DENTAL COMPLICATIONS

Another group of cases are those in which the cough, sputum and pulmonary signs are secondary to a focus of suppuration about the teeth. Appropriate dental treatment has frequently resulted in complete recovery.

3. DISEASES OF THE BRONCHIAL TREE

A great many cases on study are thrown into the class of bronchitis or chronic bronchitis and debility. The cases of chronic bronchitis form a large group. We find this disease develops in a great many men in the British training camps and this is especially true of men past 35. Emphysema and chronic bronchitis have long been known as a disease of old soldiers. The severe and prolonged exposure in the present war is resulting in the development of these conditions in a large number of old soldiers. With prolonged bronchitis, debility frequently supervenes and we then have a group of symptoms simulating tuberculosis. If an X-ray examination is made, there may be found evidence of old calcareous deposit either in the hilum or peribronchial tissue. Care here should be taken to judge fairly whether a man is suffering from tuberculosis or whether he has simply a bronchitis, with the evidence of old healed tubercle which has not been activated by the recent infection.

Chronic bronchitis and debility secondary to infection about the teeth are frequently seen in men past middle age and we find the dental department of great service to us in clearing up these cases.

There is no more interesting group of cases than those that have bronchiectasis. I have seen in the last six months twelve cases, ten of which were diagnosed tuberculosis clinical. In none, however, have tubercle bacilli been reported. More care and attention to history and physical examination would lessen the possibility of this error, an error which is perhaps natural if physical signs alone be considered, yet here we can surely be on our guard, because the signs of bronchiectasis are more particularly limited to the lower lobe and the presence of clubbed fingers should warn us that we have probably to deal with bronchiectasis, which may or may not be due to a tuberculosis. The cases of upper lobe bronchiectasis form a more difficult group, but even here the persistent absence of tubercle bacilli, in the patient with fairly profuse purulent expectoration, must argue against a diagnosis of tuberculosis.

When well developed the diagnosis of bronchiectasis should not be difficult when sputum is so suggestive, both in character and amount. With clubbing of fingers and lower lobe lesion the findings are rather against tuberculosis. It is to be remembered too, that hemorrhage of one or two ounces or even larger amounts is not infrequent in bronchiectasis. In its earlier stages diagnosis is more difficult and the cases

will run along for considerable time with only the symptoms and physical signs of a chronic bronchitis. We have had a few such cases in which for a time the symptoms and physical signs were rather vague, but in the course of eighteen months they become definite.

4. PULMONARY DISEASES

Pneumonia which has been subacute in its onset and course is not infrequently preceded by a period of cough, or, as a patient describes it, a prolonged cold for two or three weeks. If this patient be examined during the stage of resolution, the dulness, the character of the breath sounds and the bubbling râles all suggest the moderately advanced or advanced tuberculous lesion, apparently explained by the preceding cough. These cases, however, usually clear promply, and the diagnosis is soon corrected. In some patients with symptoms of chronic bronchitis, we find persisting some localized râles in one or both of the lower lobes. These adventitious sounds may vary somewhat in character and are sometimes accompanied by sibilant and sonorous rhonchi. The outstanding feature is their persistence and the fact that they are well brought out with cough. They suggest the presence of a chronic broncho-pneumonic condition, but there is rarely alteration in the respiratory murmur. We have seen a goodly number of these and speak of them as chronic lower lobe infections. I have seen a number which have been diagnosed as tuberculous infections, but in none was I able to confirm the diagnosis. The first case I saw has taken nearly three years to clear up. Two others have been under observation nearly two years and are slowly clearing; some have cleared within six to twelve months.

5. PULMONARY ABSCESS

Occasionally this condition is confused with tuberculosis,—the cases which do not have fetid sputum. There should, however, be no confusion in a patient with profuse expectoration, whose sputum under repeated examination shows no tubercle bacilli. The diagnosis of tuberculosis is never to be made without very careful consideration of all symptoms and physical signs. In one case, with well marked involvement of the left upper lobe, the diagnosis of tuberculosis was repeatedly made, in spite of the fact that tubercle bacilli were constantly reported absent.

6. DISEASES OF THE PLEURA

Pleurisy with effusion. To-day we believe that a large proportion of cases of pleurisy with effusion are due to the tubercle bacillus. In these cases we believe that there is always a preceding focus, in the mediastinal or tracheo-bronchial glands. Some patients with pleural tuberculosis subsequently develop pulmonary tuberculosis; a large proportion do not. It is not infrequent to find the diagnosis of pulmonary tuberculosis made on the strength of dulness and limitation of movement found after pleurisy with effusion, which are due to pleural adhesion and partial collapse of lung. Because a man has had a tuberculous pleurisy with effusion, it does not necessarily follow that he has a pulmonary tuberculosis as well.

7. EMPYEMA

Empyema which goes on to operation, rarely offers any difficulties, either in its usual position or inter-lobar. The type, which has evacuated spontaneously into a bronchus, has at times been confused with tuberculosis; here the diagnosis to a great extent is cleared up by careful history taking. For example,—a patient gave the history overseas of having had a pneumonia with high fever persisting for two or three months, with constant expectoration. At that time, eight or ten months later, though less, it had not cleared up completely. There was well marked debility and inability to carry on. Occasional evening temperature of 99° to 99.2°. No tubercle bacilli were found in the sputum. On this history the diagnosis tuberculosis suspect was made. On more careful attention to the history, we learned that the high daily fever of 101° to 103° at the time of the pneumonia persisted for about three months, but fell promptly when about one quart of pus was expectorated. In the course of 24 hours the temperature rose again, persisted for a week and again fell to normal when about a pint was expectorated; since that time (two and a half years) a little cough and sputum persisted with evening temperature. Upon return to Canada, we found left basal dulness, slight scoliosis and the left half of the subcostal angle definitely narrowed. The wrong diagnosis was made here because of incomplete and insufficient history taking, and the patient passed through several hospitals without change of diagnosis, owing to the fact that the original history was accepted and not retaken.

8. GUNSHOT WOUNDS OF THE CHEST

In some cases of gunshot wounds of the chest there is persisting cough, sputum and debility. The cough in some cases would appear to be due to a chronic bronchitis, perhaps infective in nature, in others doubtless due to injury to the bronchi. In some cases bronchiectasis follows; in fact, one would expect more cases of bronchiectasis following the injury to the bronchi by foreign bodies penetrating the chest. In other cases cough persists following the resultant empyema and the physical signs and symptoms, together with debility, suggest tuberculosis.

Other injuries to the chest sometimes result in changes, which associated with cough, raise the question of the presence of tuberculosis. These cases, of course, all require individual review.

9. OTHER PULMONARY CONDITIONS

A large number of cases of emphysema have been returned to Canada because of a chronic bronchitis. We have been struck by the proportion of these cases which show impaired resonance in the apices and lack of movement, perhaps retraction, and in whom the X-ray shows apical shadowing, or even calcareous deposit. We observed somewhat similar chest findings in some cases of asthma, particularly in men of 40 to 50, with full abdomen. In these cases we have no room for doubt that a man has an anatomical tuberculosis, but the obsolete lesion has not been activated by service and is not now disabling.

10. CONDITIONS SECONDARY TO HEART AND CIRCULATION

Mitral stenosis. We find certain cases with debility, cough, blood-stained morning sputum, pain in the chest, and, upon physical examination, localized râles, which may be apical or basal. These symptoms so simulate pulmonary tuberculosis, that it must be remembered that they are also symptoms of this form of heart lesion.

We have seen two cases of aortic regurgitation, in which, because of the absence of the usual murmur from its usual situation, the symptoms led to the diagnosis of tuberculosis.

We have seen three cases of chronic congestion secondary to hypertension, confused with tuberculosis, because of a debility, shortness of breath, occasional blood-stained sputum and diffuse râles.

11. GRAVES DISEASE

We have seen four cases in which we felt justified in changing the diagnosis, tuberculosis clinical or tuberculosis suspect, to hyperthyroidism. In two, the goiter had been recognized, but the symptoms unnecessarily ascribed to co-existing tuberculosis.

12. GAS POISONING

The symptoms of gas poisoning are varied. Those referable more particularly to the respiratory system are cough, pain or oppression in the chest on exertion and dyspnea on slight exertion, particularly when walking on any incline. In the presence of slight apical changes or old standing asymmetries of the chest, tuberculosis is often suspected. It was generally anticipated that the chemical damage to the bronchial mucous membrane and the resultant inflammation would result in the aggravation of any latent tuberculosis. This, however, has not been the case. Although a large number of men in certain sectors have been again and again exposed to gas in varying quantities, we find amongst our cases of tuberculosis very few who have become casualties through being gassed.

In 1000 French soldiers suspected of tuberculosis, Kindberg and Delhirm found one or two in which the gas bore relation to the onset of their illness. Other French authors report only three cases among 206 soldiers suffering from tuberculosis. Stewart of Ninette says, "Gas poisoning is most horrible and most deadly in its effects, but pulmonary tuberculosis is not one of these effects. In more than 300 soldiers admitted to the Manitoba Sanatorium for treatment, of whom many had been more or less gassed, in no case did this seem to be in any measure responsible for the disease. In two or three in whom after effects of gas were marked, tuberculosis could not be diagnosed."

THE MALINGERER

The existence of this type of patient must be remembered in the army, even more than in civilian practice. The old army officer knows him well, and in peace times it was often a pleasant battle of wits between the man and his officer as to who would win out, and there was but little malice borne, Amid the stern realities of war, the malingerer must be watched for and firmly dealt with. Men with slight cough and faint

heart, or who wish to live in comparative comfort, have with little sputum, been known to substitute a specimen for examination. Hemorrhages are at times rather cleverly simulated and I have known the patient to so manipulate his thermometer as to have the nurse record a daily rise of temperature. One of the most outstanding cases I have observed, is a man who in two hospitals under close observation, had severe recurring pulmonary hemorrhages with high temperature, and who later when apyretic and free from cough and sputum and with his X-ray plate showing little demonstrable lesion, deceived his nurse for a period of some months with fake hemorrhages and a faked irregular rise of temperature.

What are the causes which lead to a wrong diagnosis of tuberculosis? The wrong diagnosis is perhaps due to some of the following:—incomplete or inaccurate physical examination, imperfect history taking, over-estimation of the importance of slight variations in temperature, failure to recognize that asymmetries of the chest are symptoms of a past disease, rather than a present disease, failure to appreciate the fact that with outstanding physical signs simulating tuberculosis and with profuse expectoration, tubercle bacilli in the sputum are usually requisite to an absolute diagnosis. We endeavor to diagnose incipient disease before bacilli appear in the sputum, *but given purulent sputum, showing no tubercle bacilli on repeated examination, tuberculosis is not probable.*

In differential diagnosis a wide experience in internal diagnosis, particularly in the department of respiratory diseases, is most important. The man who is purely sanatorium trained, understands thoroughly the *treatment* of tuberculosis, but a knowledge of non-tuberculous pulmonary conditions is best assured in the wards or the out-patient department of a large hospital.

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* "The Choice of Tuberculins," by Benjamin White, Otisville, N. Y., Department of Health, City of New York. Read at the annual meeting of the Medical Society of the State of New York, at Saratoga Springs, May 18, 1916.

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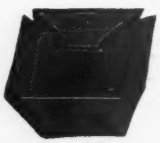

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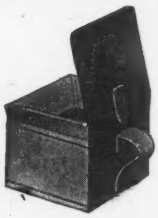

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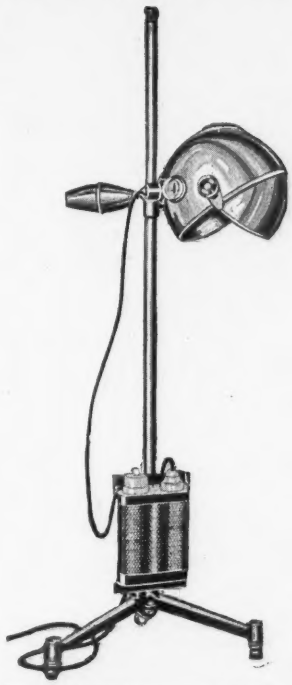

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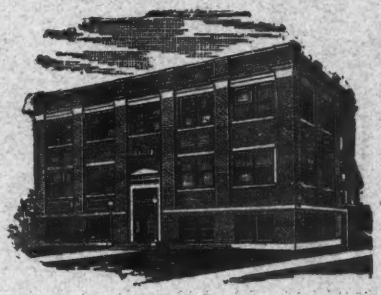

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